PROFILE PUBLICATIONS

The Morane Saulnier 406

NUMBER 147

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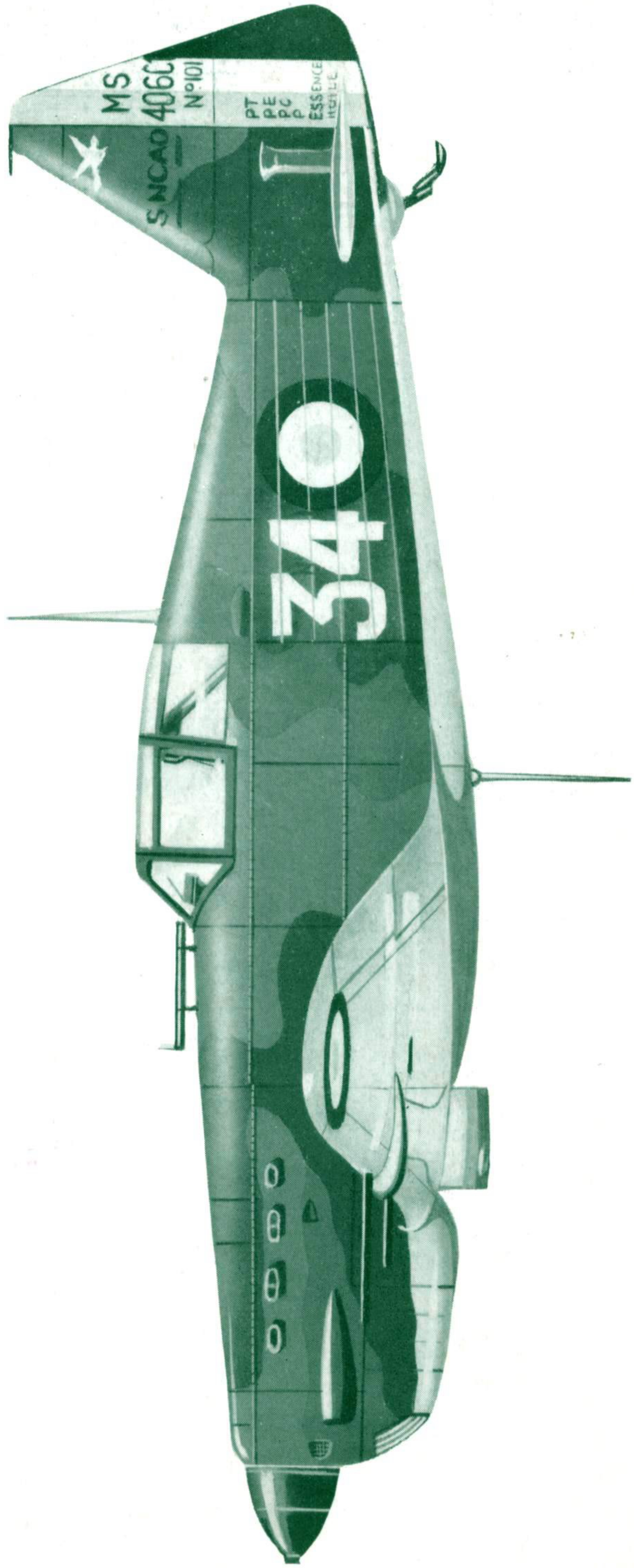
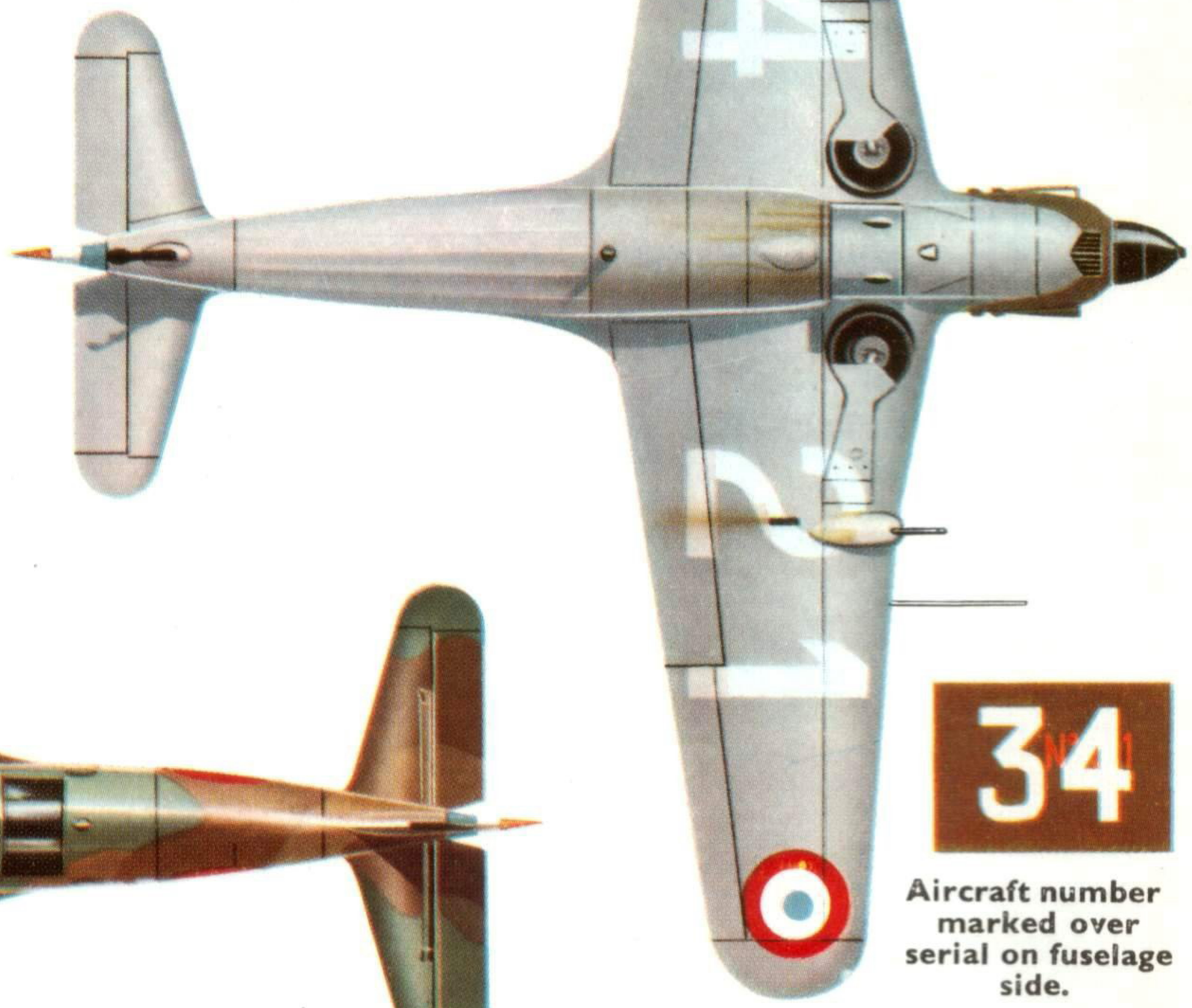
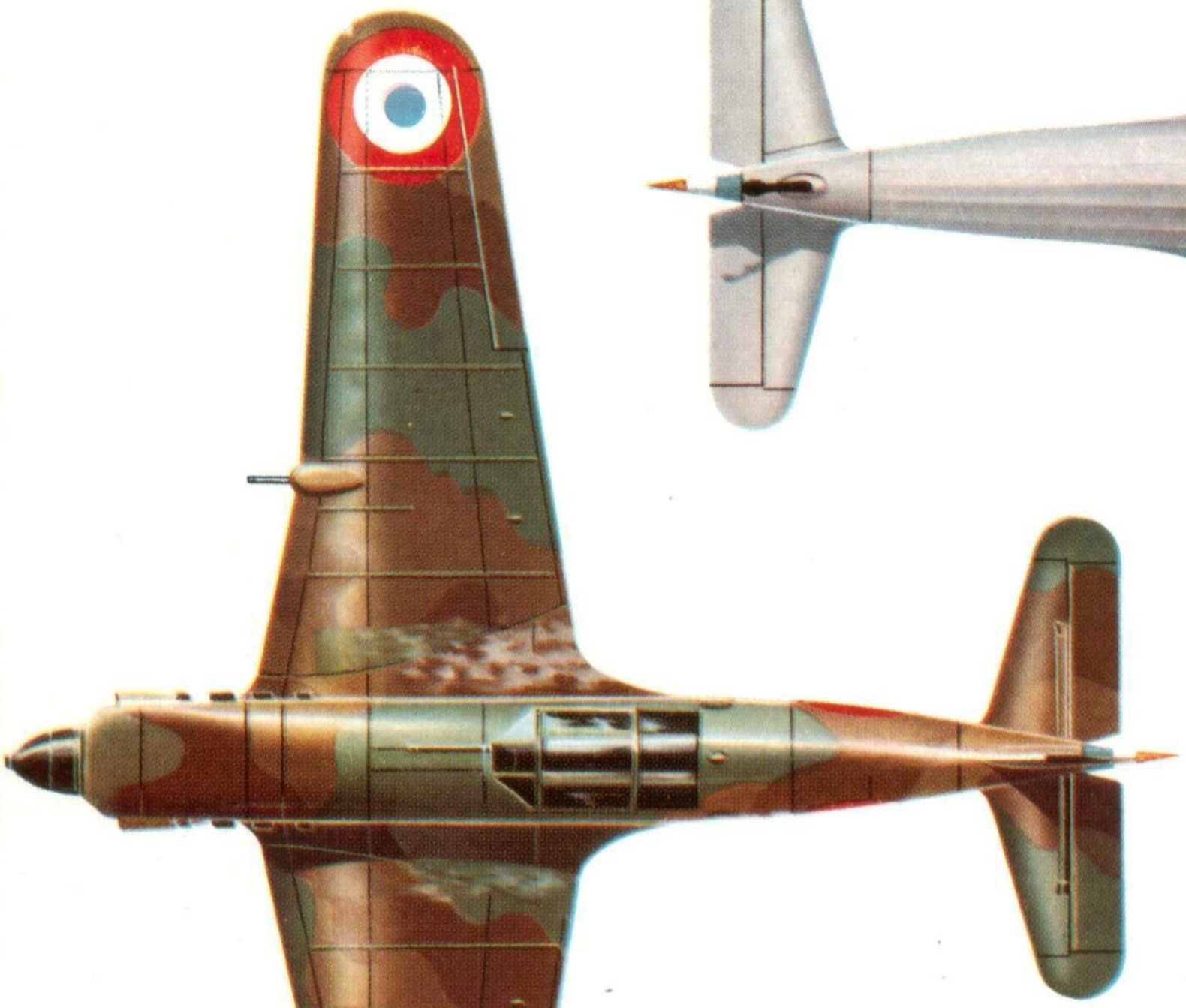




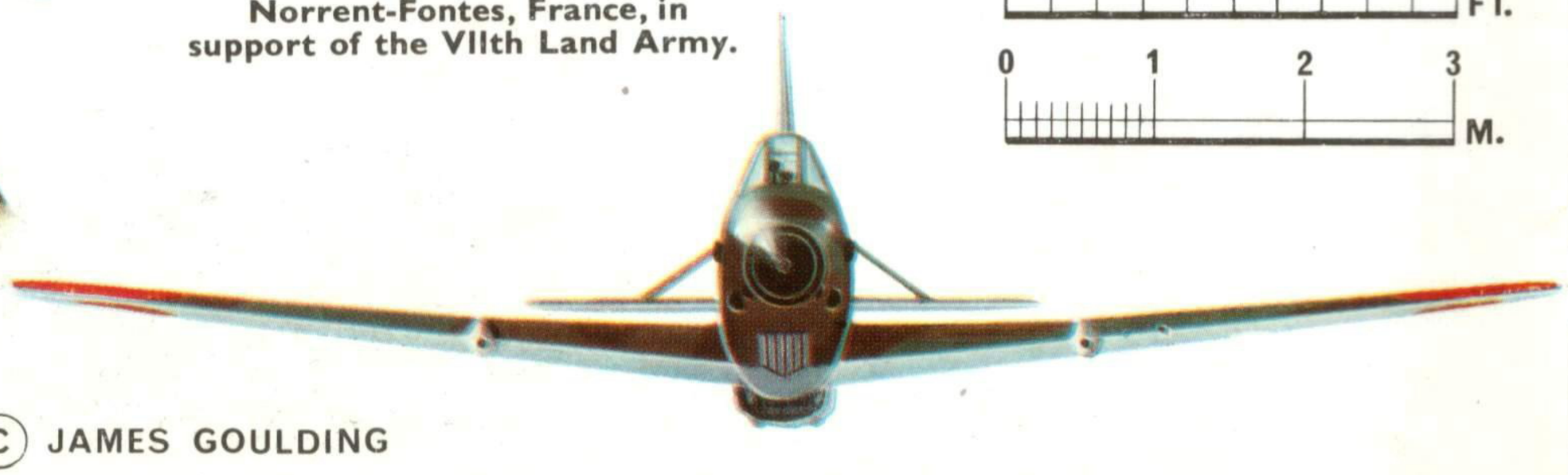
G.C.III/1, 6th Esc.
(SPA 93)



Aircraft number marked over serial on fuselage side.

Rudder stencil details.

Morane-Saulnier 406, No. 101, of Groupe de Chasse G.C.III/1, 6th Escadrille (SPA 93); on 10th May 1940 this unit was based at Norrent-Fontes, France, in support of the VIIth Land Army.



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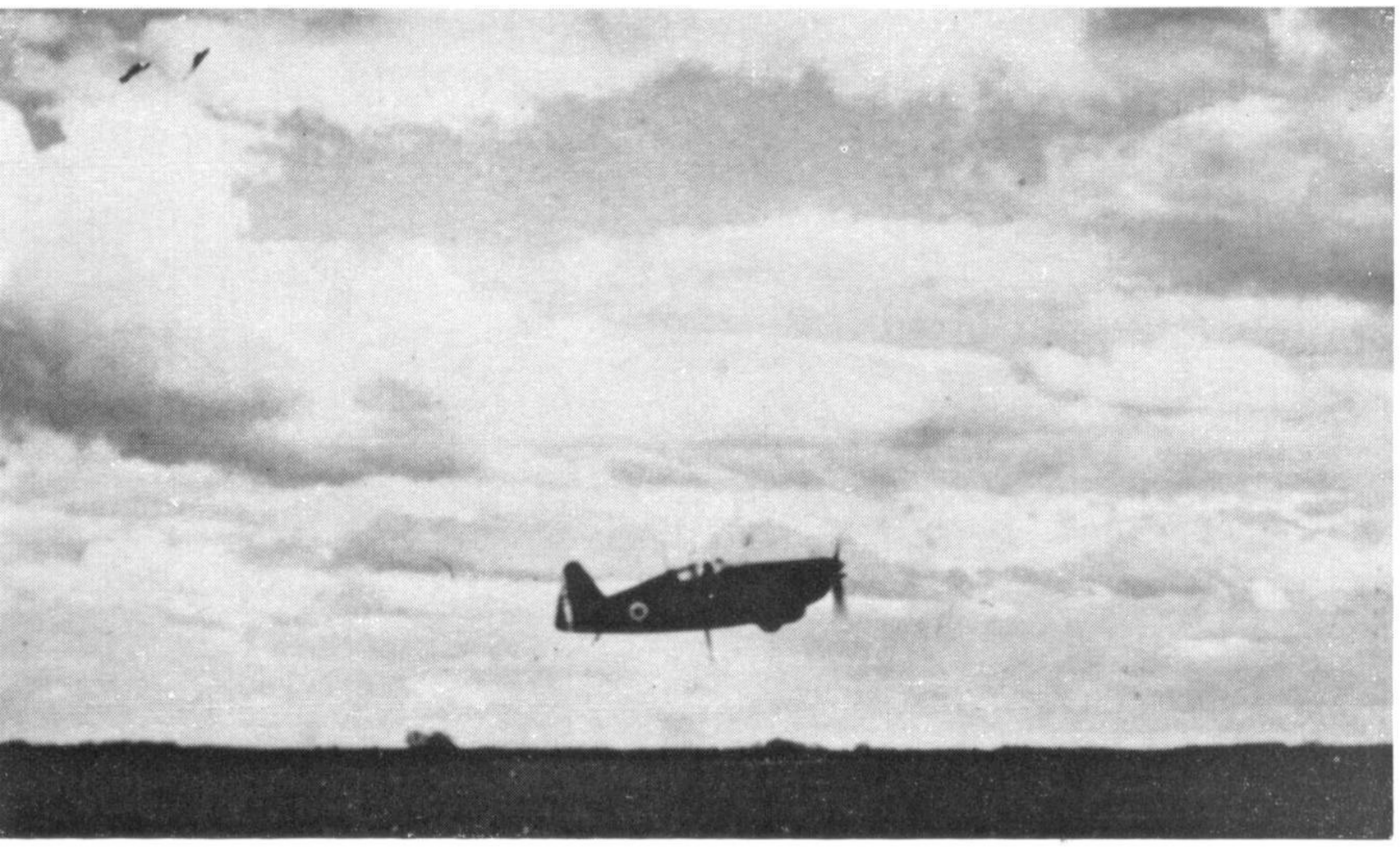
The Morane Saulnier 406

by Gaston Botquin



The distinctive silhouette of the Morane-Saulnier 406 against the evening sky "somewhere in France" in 1940. Outclassed and outnumbered, the M.S. 406 had no real chance against the Luftwaffe, *but the exploits of its defiant pilots have assured its place in the story of the early war years.* (Photo: E.C.A.

Since before World War One, the firm *Aeroplanes Morane-Saulnier* had produced fighter and training aircraft for the *Armée de l'Air*, specialising until the thirties in high- (and slightly tapered-) wing monoplanes, or "Parasols". The first low-wing Morane, the M.S.325, did not appear until 1932. In 1934 the *Armée de l'Air* issued a specification for a modern interceptor fighter to replace the D.500, LN 46 and D.371 aircraft. In response to this the Morane designers at Puteaux projected a low-wing monoplane with such features as a retractable undercarriage, enclosed cockpit, landing flaps and a variable-pitch airscrew.

In July 1937 the Morane-Saulnier M.S.405 was selected from five competing prototypes for a production order (the other competing aircraft were the Bloch 150, Dewoitine D.513, Loire 250 and Nieuport 161); the winner was to receive production contracts totalling more than a thousand aircraft. As the Puteaux plant was not large enough to produce so many aircraft, the recently-nationalised French aircraft industry was introduced into the production process.

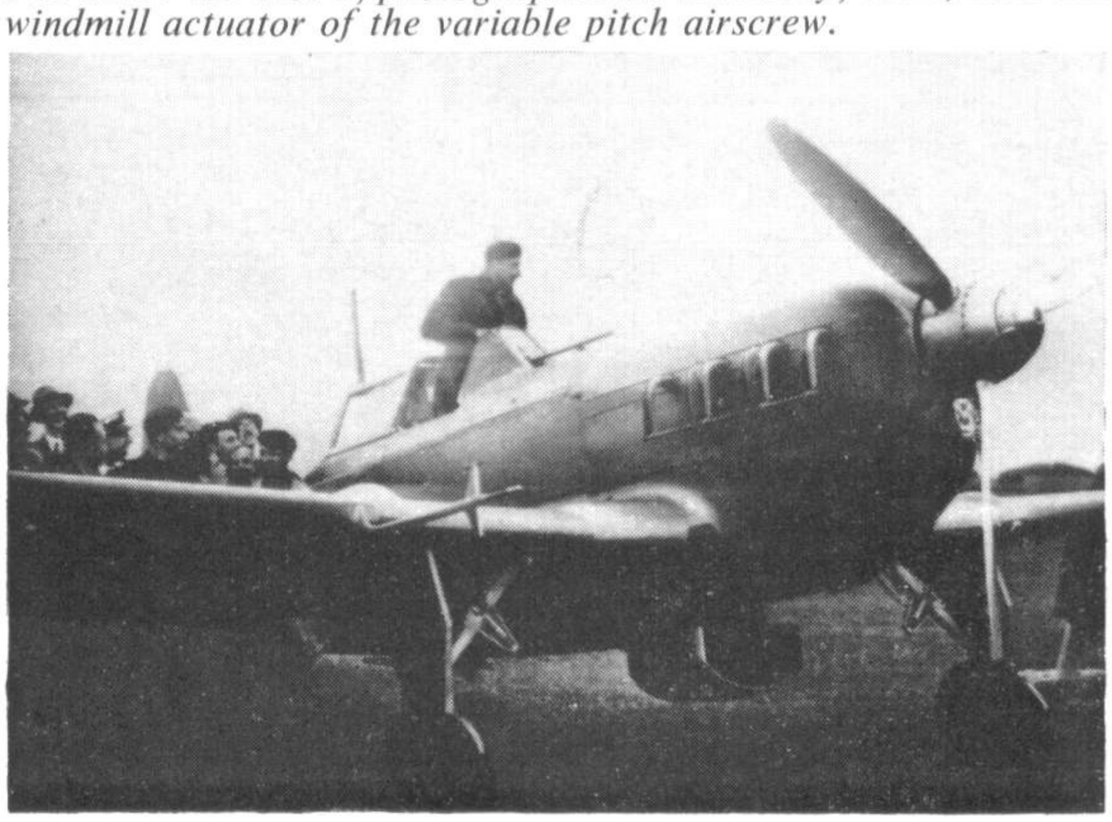
From a material and psychological point of view, the introduction of the M.S.406 into the *Escadres de Chasse* at the beginning of 1939 was an important event. It was the first modern fighter in French service and the "traditional" biplane supporters argued with the "modern" monoplane supporters around its shapely lines.

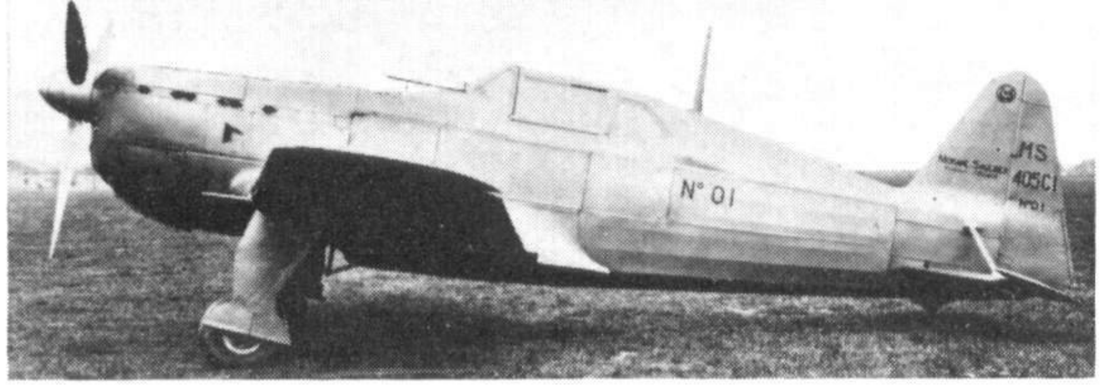
In September 1939, when war broke out, about 600 M.S.406 aircraft had come off the assembly lines and, with the 170 Curtiss H.75 aircraft received from the U.S.A., (see *Profile* No. 80) they were the only French fighters capable of opposing the *Luftwaffe*. It must be said that the French aircraft industry, so often described as inefficient, had delivered 600 modern fighters in the eighteen months succeeding the first flight of the first production M.S.406. This figure compares well with the Hawker Hurricane I (see *Profile* No. 111) of which 497 were produced in twenty-three months. It would be pointless to pretend, as was often done during the war for propaganda purposes, that the M.S.406 was the finest fighter in the world, *le meilleur chasseur du monde*, but it was certainly a pleasant machine to fly with no vices and great manoeuvrability. Unfortunately it lacked most of the attributes of a real "war bird", but this gives more value to, and enhances, the gallantry of the French pilots who gained victories flying the type.

THE M.S.405 AND DERIVATIVES

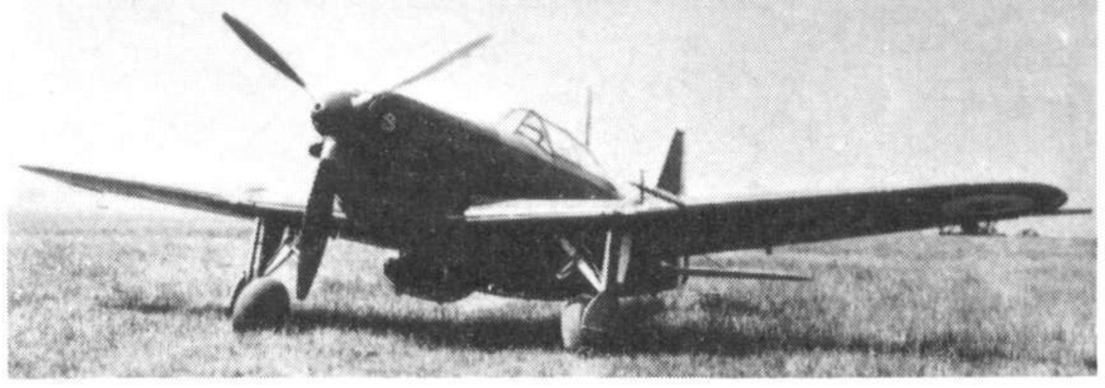
Built at Puteaux, the prototype M.S.405-01, powered by a Hispano-Suiza HS 12Y grs engine, had no retractable landing-gear but a fixed mounting which was replaced by a retractable Olaer undercarriage after its first flights. The famous aerobatic pilot Michel Detroyat piloted the M.S.405-01 on its first flight from Villacoublay on 8th August 1935. The excellent flying characteristics of the prototype were immediately apparent. After 80 hours of test flights, the prototype was delivered to the *Centre d'Essai du Matériel Aérien* (C.E.M.A.) in January 1936, with all military equipment fitted, for Service testing. Some modifications were necessary to the wing planform and dihedral, and the Chauvière airscrew was replaced by one of Levasseur manufacture. Excellent performance was recorded in tests, speeds of 250 m.p.h. being recorded near the ground and 304 m.p.h. at 13,100 ft. and a speed of 450 m.p.h. was easily attainable in a dive. The prototype received considerable publicity when, on 14th June 1937, M. Detroyat flew the aircraft from Paris to Brussels, bearing the civil registration F-AKHZ, to exhibit it at

The M.S. 405 No. 1, photographed on 12th July, 1936; note the windmill actuator of the variable pitch airscrew.





The prototype M.S. 405-01 before flight testing. (Photo: Musée de l'Air)



M.S. 406 No. 4, the fourth pre-production aircraft and the true prototype of the M.S. 406 series. (Photo: E.C.A.)

the Brussels Aeronautical Exhibition.

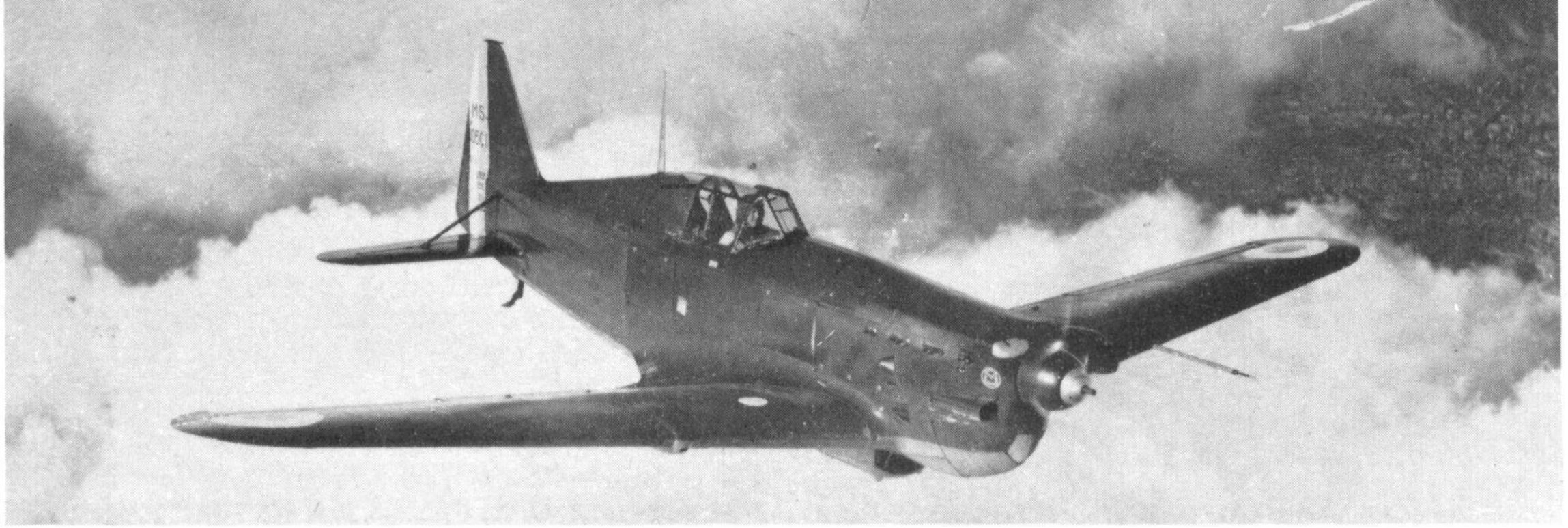
The second prototype, the M.S.405-02, first flew in February 1937 and differed considerably from the first aircraft. The wing planform was modified, the engine drove a Levasseur airscrew through a 2:3 reduction gear in place of the 48:51 gear of the M.S.405-01. The aircraft was delivered to the C.E.M.A. in June and was destroyed on 29th July 1937, killing test pilot Ribière. Shortly before the fatal crash, on 18th July, the M.S.405-02, piloted by Rozanoff, was displayed in company with the M.S. 405-01, piloted by Detroyat, at the Le Bourget Air Meeting.

Fifteen pre-production M.S.405's were officially ordered in March 1937 (Order No. 274/7), although the Puteaux factory had been preparing for production since August 1936. On completion, the aircraft were transferred from Puteaux to Villacoublay, assembled, and flight tested, mainly by test-pilot Launay. A regular rate of production was maintained; No. 1 first flew on 3rd February 1938, No. 2 on 2nd July, No. 3 on 5th May, No. 5 on 16th June, No. 6 on 23rd June, No. 7 on 2nd July, No. 8 on 8th July and the fifteenth, and last, in December. Construction and testing of these machines provided information for the production version, the M.S.406 and also for the various export versions. The first five M.S.405's required an average of 33,000 work hours for completion and cost 965,000 Francs each (1937 value). Normally fitted with an H.S. 12Y crs engine, the M.S.405's were structurally identical up to No. 11; from No. 12 the number of ribs in the wing was reduced, resulting in a weight saving of 200 lb.; the original radio equipment of Thomson manufacture was replaced by a Radio-Industrie set.

The M.S.405 No. 4 (first flight 20th May 1938) was the prototype for the production M.S.406 being fitted with an HS 12Y 31 engine driving a Chauvière airscrew. The machine was delivered to the C.E.M.A. on 23rd May 1938 after four flights. Nos. 3 and 10 respectively served as models for sub-contractors S.N.C.A.O. (Bouguenais) and S.N.C.A.M. (Toulouse). No. 12 (first flight 11th October 1938), when fitted with a non-retractable radiator and a 950 h.p. HS 12Y 45 became the M.S.411 and flew in this form, with a non-retractable radiator, for the first time on 24th January 1939. This was in fact the prototype for the Swiss D-3801. No. 13 was exported to Switzerland after modification to M.S.408 standards. Allocated the Swiss serial J-1 it became the prototype for the D-3800; first flight and acceptance trials were conducted at the beginning of October 1938. No. 14 was the first prototype of the M.S.407 L.P. (*Lance Parachute*) designed for the study of high-speed parachute-dropping; modifications included an additional compartment in the fuselage in place of fuel tanks, these being fitted in the wings. M.S.407 L.P. No. 1 first flew on 7th December 1938 and two more followed during 1939. After testing at the C.E.M.A. at Villacoublay until the beginning of 1940 they were reconverted to M.S.406 standards.

Apart from the M.S.405, 406, 407, 408 and 411 already mentioned, two further derivatives of the basic design deserve mention at this stage. The first, the M.S.409, embodied a new horse-shoe shaped radiator placed directly under the engine in the same style as the Curtiss P-40 (see *Profile* No. 35). The second, the M.S.410, appeared later and resulted from modifications made in the light of combat experience obtained in the autumn of 1939. The M.S.410 had a reinforced armament of four MAC 1934 machine-guns with 550 rounds per gun in belts. The cockpit and the wing guns were heated by hot air coming from a heat-exchanger placed on the port-side engine exhausts; the guns were heated by the air which had passed through the cockpit. A modified windscreen was also fitted to permit the mounting of a new reflector gunsight, armament control was electro-pneumatic, and provision was made for the carriage of auxiliary fuel tanks under the wings. The first prototype, No. 1028, had a fixed radiator; the second followed in January 1940 (No. 1040). In February 1940, the authorities ordered that 500 M.S.406 aircraft be brought up to M.S.410 standards. The modified wings were to be produced at Bourges (S.N.C.A.C.) and Billancourt and modifications took 15 days; because of the great need for modern fighters during the Battle of France, all conversion work was stopped in May. In fact, only five complete aircraft and 150 sets of wings were produced before work was

M.S. 405 No. 2; note windmill actuator of airscrew, and long wheel wells. (Photo: Morane-Saulnier)



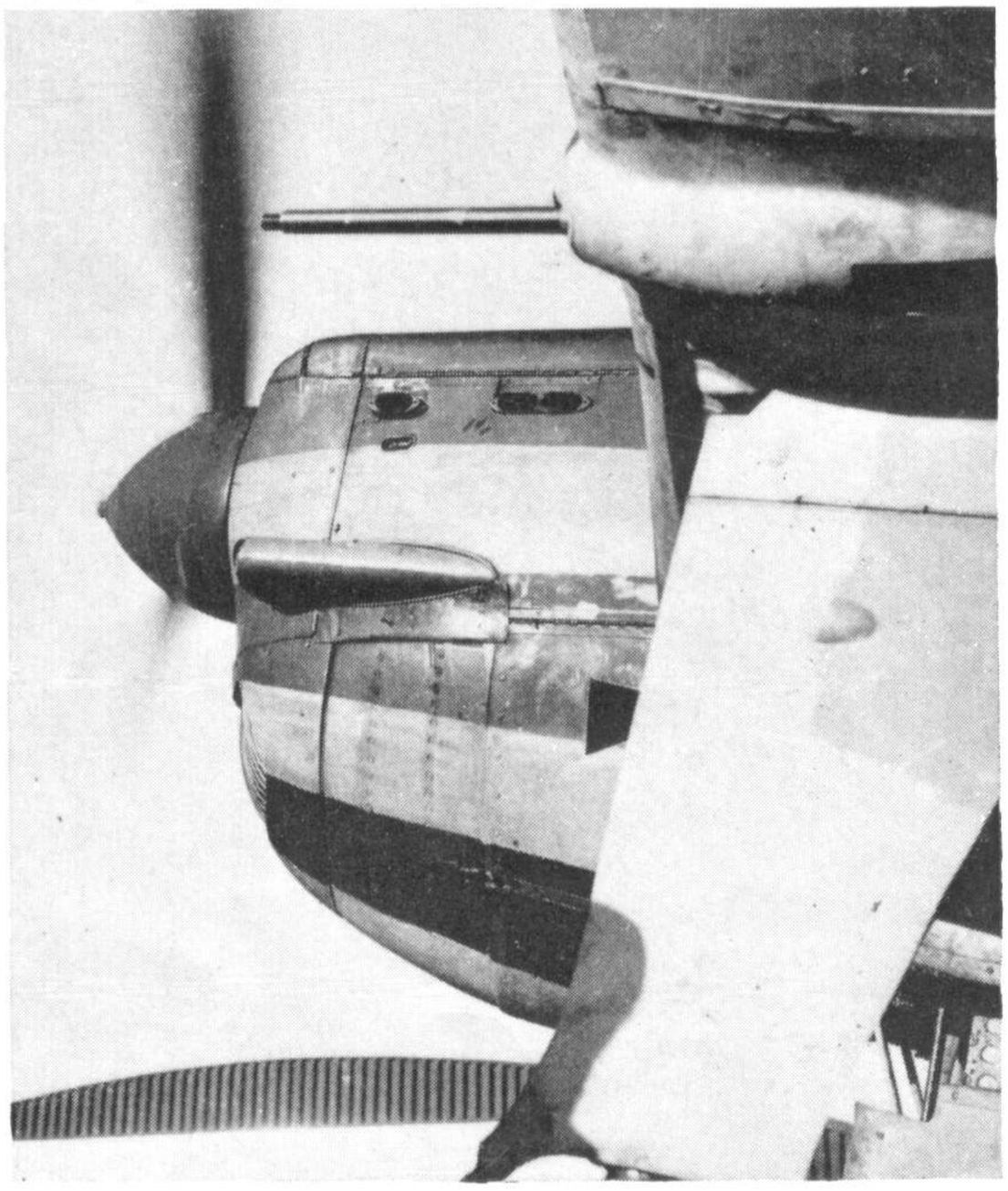
Flight testing of M.S. 405 No. 11; a fine study which shows surface details to advantage. (Photo: Morane-Saulnier)

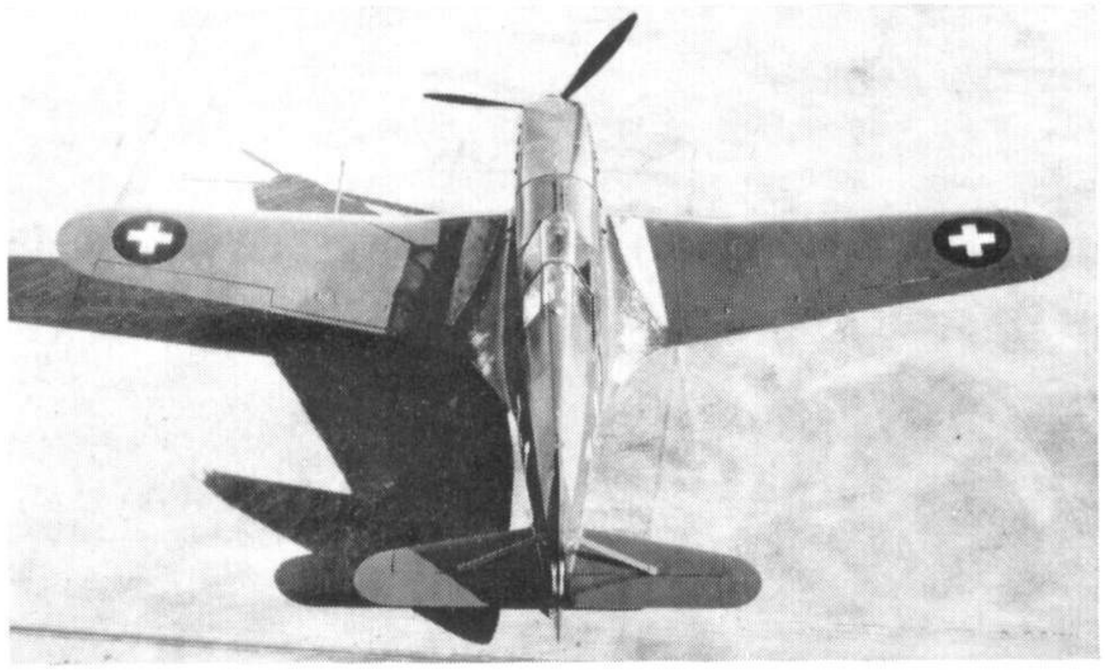
stopped, priority being given to aircraft with Ratier airscrews.

THE MORANE 406 DESCRIBED

Like most fighters, the M.S.406 was built around the motor, the already classic liquid-cooled Hispano-Suiza 12Y. The "*moteur-canon*" HS 12Y 31 was a 12-cylinder, 60° Vee in-line engine giving 860 h.p. at 2,400 r.p.m. at sea-level with a compression ratio of 5·8:1. The crankshaft, driving a reduction gear of 2:3, was hollow to allow the cannon to fire through it. The propeller rotated clockwise. Most production aircraft had short, straight tube exhausts, but the first M.S.406's and most M.S.405's had a downward stainless-steel Bronzavia exhaust-collector for night-flying fitted. Exhaust propulsion was tested with remarkable success in 1940 on M.S.406 No. 1035 and on No. 1005, speed gain at optimum altitude being 25–27 m.p.h. The motor drove an oil pump providing hydraulic pressure to operate the flaps, radiator position and landing-gear retraction. Brakes, armament-triggers, the Viet engine-starter, landing-gear locking and emergency fuel-jettison were operated by compressed air, while a DC-generator supplied

Details of cowling and armament finish. (Photo: E.C.A.)



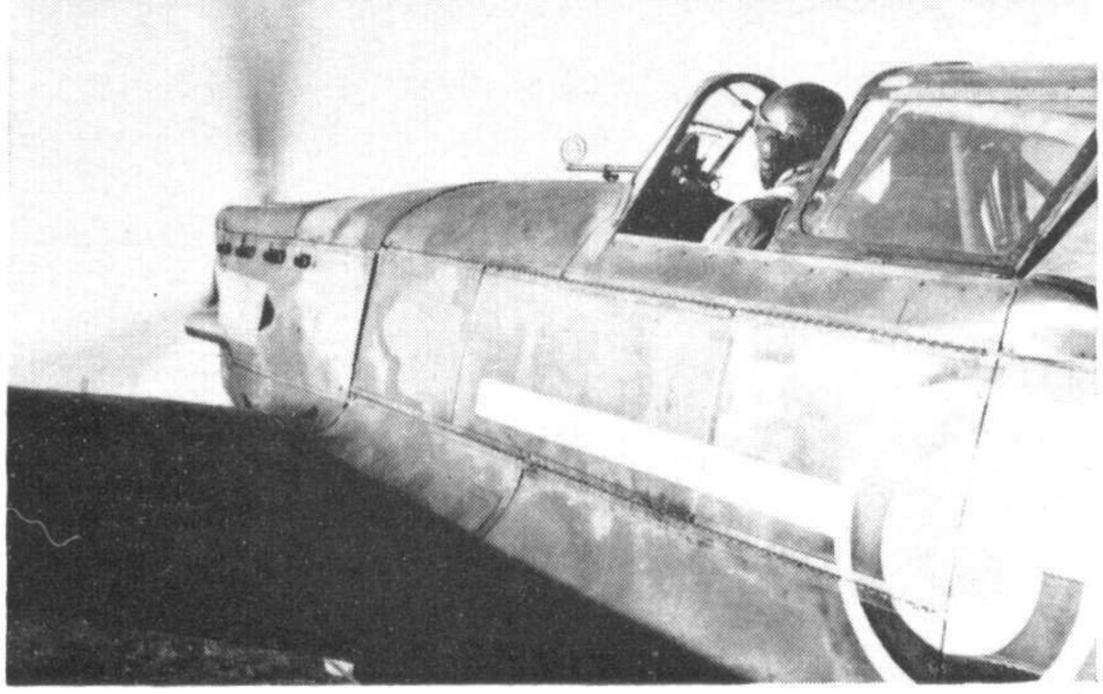


M.S. 405 No. 13 after delivery to Switzerland, coded J-1.

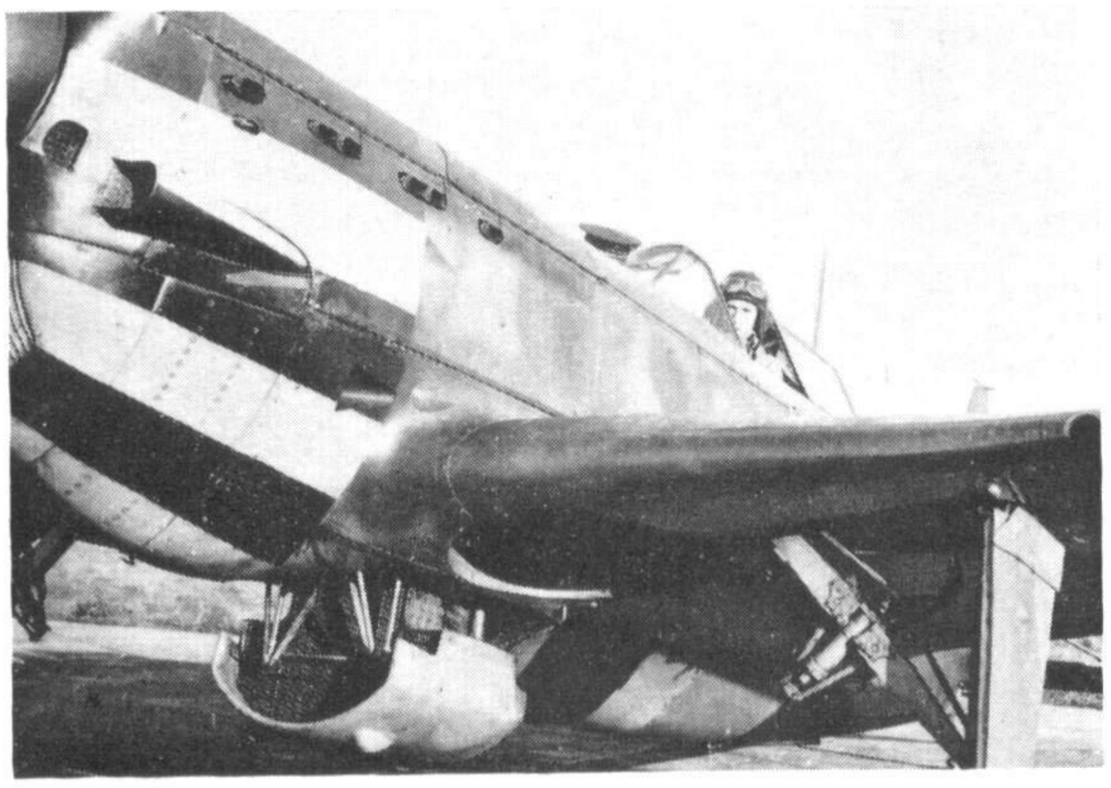
electrical power. Engine coolant was ethylene glycol. Although embodying all refinements available in 1936, four years later, in 1940, the Hispano-Suiza 12Y 31 was distinctly inferior to such engines as the Rolls-Royce Merlin and Daimler-Benz DB 601. The Viet 250 starter proved most useful on operations in 1940 as did the "*moteur-canon*". The gun, a Hispano-Suiza S9, or HS 404 in most production aircraft, was a remarkable weapon, a fact borne out by the numerous foreign orders and licences obtained for the weapon. Of 20 mm. calibre it could fire armour-piercing, explosive or incendiary shells. The drum magazine contained 60 shells, giving 12 seconds continuous firing.

The aircraft fuselage comprised the engine-bearer and the main fuselage structure of four tubular dural longerons on eight rectangular bulkheads. The first two bulkheads were of steel framework with aluminium covering, the four following of dural tubing, the seventh supported the tail-skid and the eighth was of dural. All this was generously braced by rigid supports forward and by steel wire aft.

The forward part of the fuselage up to the cockpit was metal-covered, all panels screwed or hinged onto the structure. The rear section was fabric-covered, with wooden stringers supported by Elektron formers. Initially, a two-pitch (take-off and normal) pneumatically-controlled Chauvière *Série 351* propeller was fitted, but from the end of 1939, a number of aircraft were fitted with the Ratier *Série 1607* constant-speed electrically-controlled airscrew which improved climb and acceleration performance. Aft of the fireproof engine bulkhead two fuel tanks of 88 gallons total capacity were fitted; in emergency, these could be rapidly emptied in flight by means of compressed air. The fuel tanks were interlinked, but



The hinged fuselage panels and turnover pylon are clearly shown in this view of a Vichy Air Force M.S. 406. (Photo: E.C.A.)



Nose details of an M.S. 410; note retractable radiator, and gun-port in wing leading edge. (Photo: E.C.A.)

were not self-sealing. The cockpit was enclosed by a sliding-hood and was protected by a turnover pylon of four strong steel tubes. Air-conditioning was fitted, but not armour, although after October 1939 a dorsal steel plate was fitted; the windshield, however, remained unarmoured. Gun-aiming was done by an O.P.L. *Modèle 1931* internal reflector gunsight and a ring and bead placed outside. On active service many machines were fitted with an exterior rear mirror. Behind the pilot's seat was oxygen equipment and a Ducretet Thomson 53 or Radio-Industrie 357 transmitter-receiver. Full pilot-instrumentation was fitted, permitting night-flying to be undertaken without undue difficulty.

The wings were fitted low on the fuselage with 12° dihedral and were built around two metal spars inter-connected by 11 ribs, of which three were obliquely placed, forming a particularly rigid structure. Many parts of the wing skeleton were of stainless-steel, resulting in a considerable weight-saving. The whole wing was covered in Plymax, an original sandwich material consisting of aluminium bonded to plywood, the metal being placed outside. The statically- and aerodynamically-balanced ailerons were covered with Elektron sheet. Attached to the fuselage at three points (two on the main spar and one on the rear spar), the wings contained no fuel tanks, but in each wing a drum-fed (300 rounds) MAC (*Manufacture d'Armes de Chatellerault*) 1934 machine-gun was fitted; the drum necessitated a bulged fairing. Some M.S.406's were fitted with the external flush-fitting 32 gallon auxiliary fuel-tank first tested on M.S.406 No. 1005 at the end of 1939.

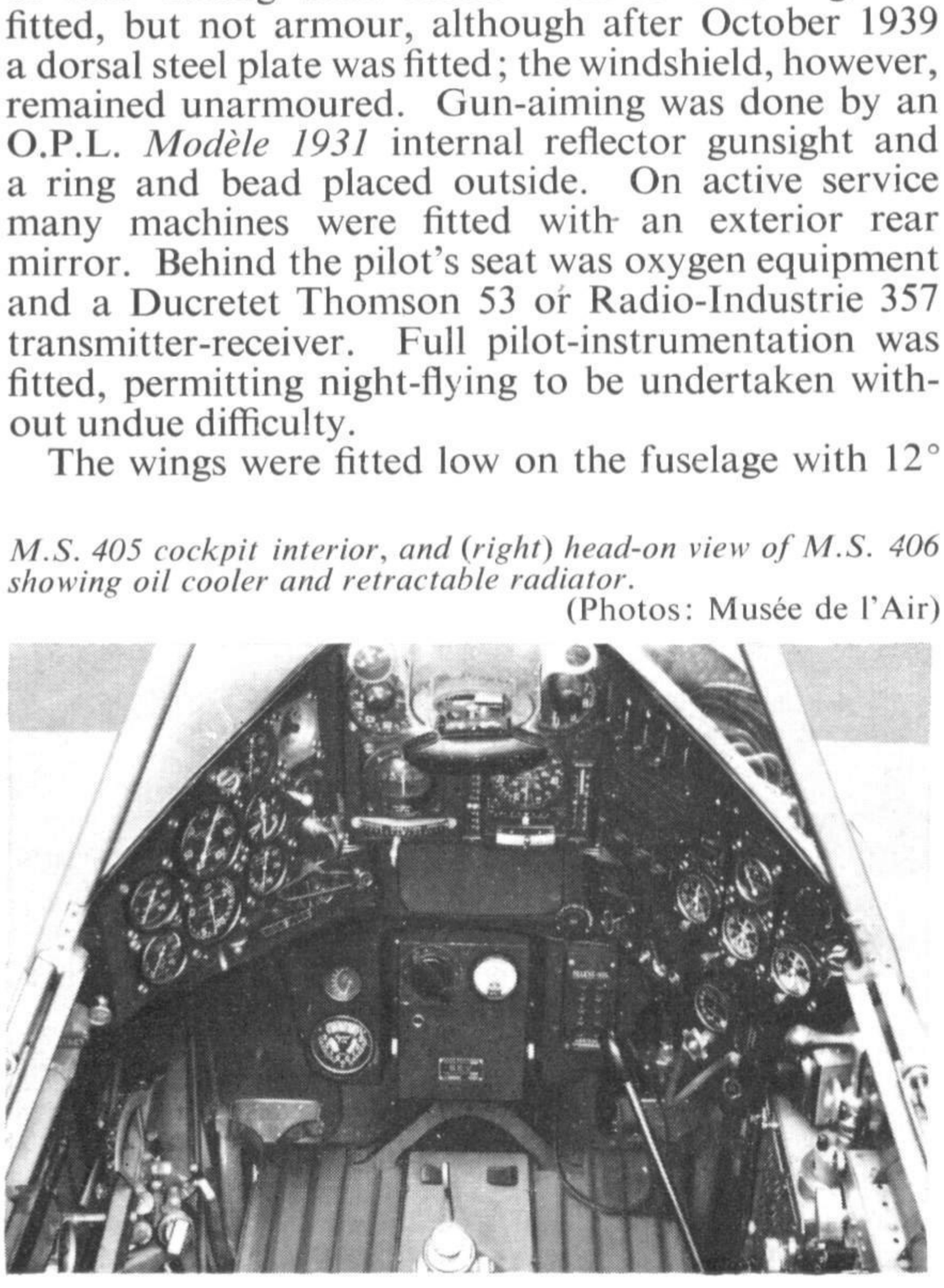
The Olaer undercarriage was hydraulically-operated and inward-retracting. Its wide-track and low-pressure tyres were very effective on the grass and unprepared airfields common in France at the time. The rear fuselage rested on a tailskid which supported about 10% of the total weight of the aircraft.

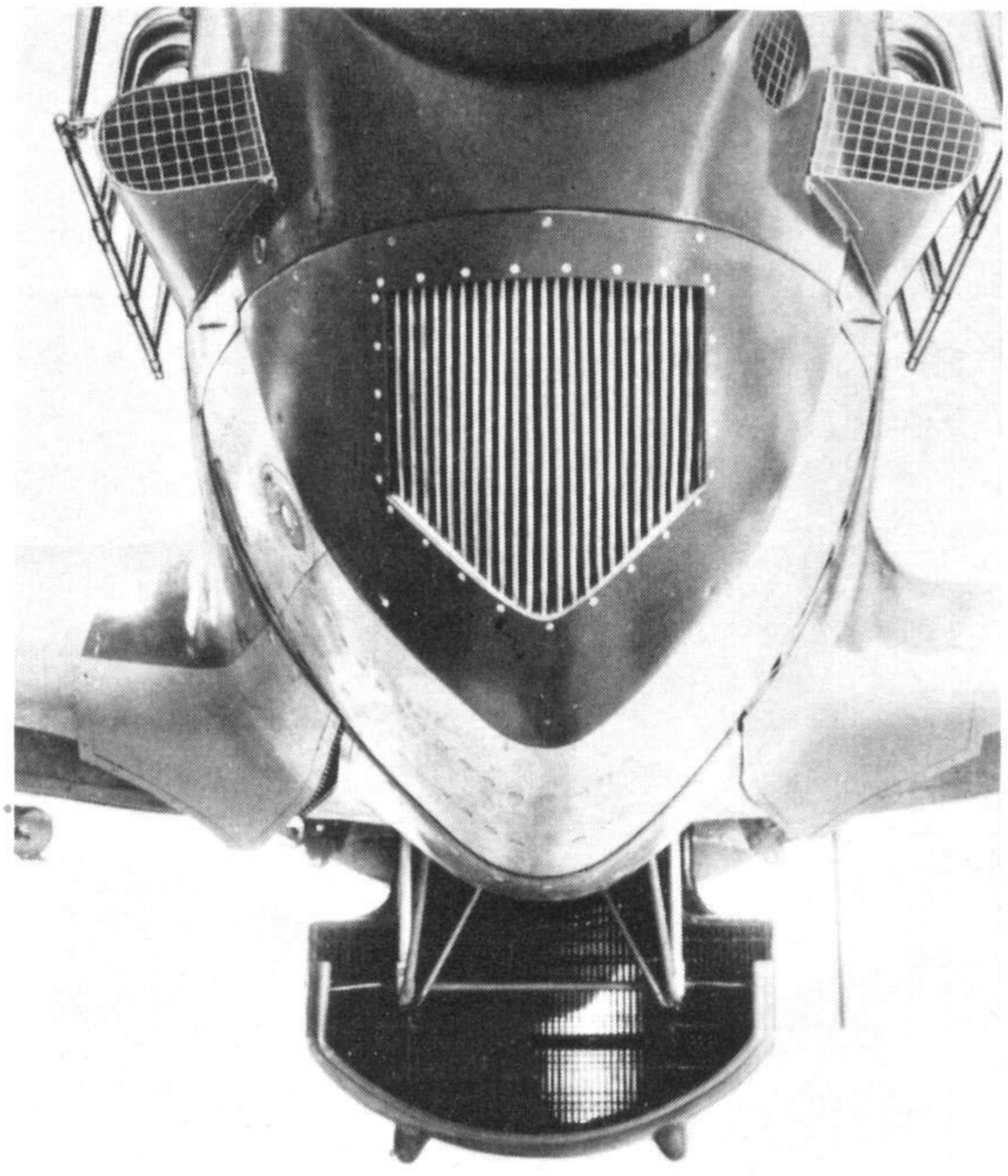
The tailplane comprised a duralumin framework covered by Elektron sheet; the horizontal plane was linked to the fuselage by struts.

As a whole, the Morane 406 possessed all the refinements needed by a modern fighter. Although not a monocoque structure, the fuselage cell was simple and rugged and its weaknesses were not structural in origin. The chief weaknesses were the complexity, fragility and vulnerability of the various actuator circuits (electrical, pneumatic and hydraulic), the low horse-power output of the engine and the inadequacy of the armament.

M.S.406 PRODUCTION

The Morane 406 and Potez 63, in its various versions, were the only French aircraft of World War Two of which more than a thousand were produced.





M.S. 405 cockpit interior, and (right) head-on view of M.S. 406 showing oil cooler and retractable radiator.
(Photos: Musée de l'Air)

In 1936, when the French aircraft industry was nationalised, the necessity of expanding and modernising the *Armée de l'Air* became obvious. The French aircraft industry was just at the end of a long period of stagnation; its 35,000 workers and technicians were not producing more than 40 aircraft per month in very poor working conditions. Under the modernisation plan, two years were to pass before results became apparent, but by the outbreak of the war 200,000 workers grouped in large enterprises were producing 300 aircraft per month. In April 1937, a first order for 50 M.S.405's (Nos. 16 to 65) was placed with S.N.C.A.O. at Nantes-Bouguenais; this order was soon changed to the improved M.S.406. A further order for 80 M.S.406's (Nos. 66 to 145) machines followed in August of that year. In April 1938, under Plan V, an order for 825 aircraft was placed with the nationalised factories, the contract being divided as follows:—

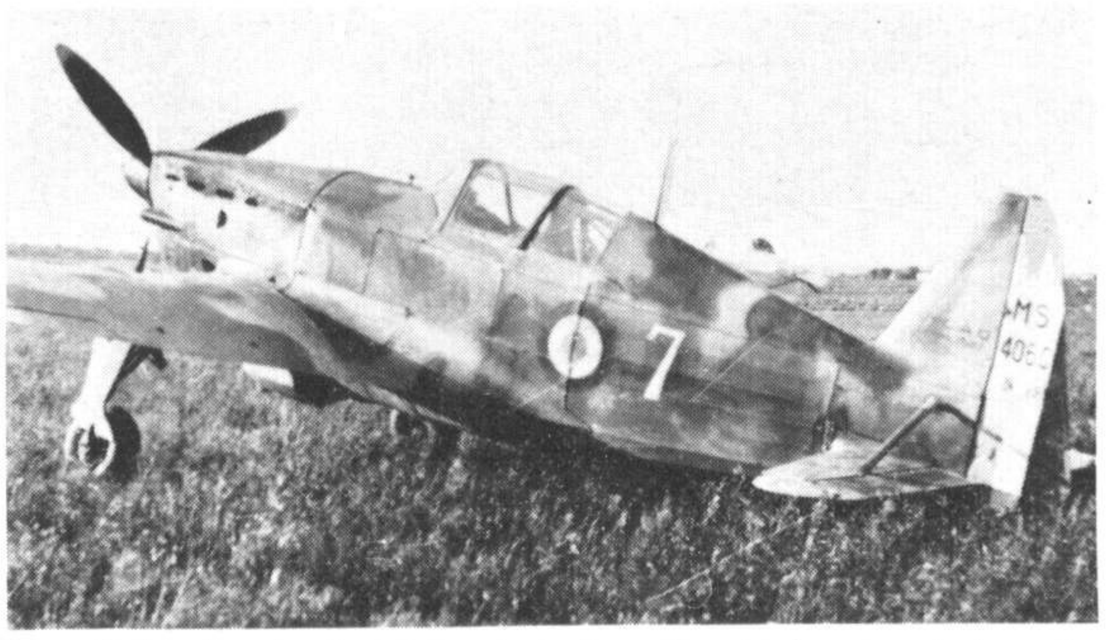
325 at the S.N.C.A.O. Bouguenais factory,
130 at the S.N.C.A.M. Toulouse factory,
370 at the S.N.C.A.C. Billancourt factory,
and 90 at the Morane-Saulnier Puteaux factory.

Except for the Morane-Saulnier order (Nos. 971 to 1060), the aircraft were to be built in nationalised factories, but under the *Plan Caquot* the scheme was altered. All aircraft were to be assembled at Bougenais, which also produced fuselages; S.N.C.A.M. was to produce tails and S.N.C.A.C. wings.

Production was slow in getting under way; in 1938 Puteaux produced 18 aircraft and S.N.C.A.O. about ten, and only 27 were accepted by the C.R.A.S. (*Centre de Reception des Avions de Série*). The C.R.A.S. received 25 in January 1939, 34 in March, 95 in May, 147 in August (a record total), 103 in October, 69 in December and a total of 932 for the whole year. Manufacturing time was a minimum of 12,500 work hours for the M.S.406. In 1940, production rate slowed as contracts were fulfilled and new types were introduced to the production lines (e.g. the Le0 451 at the S.N.C.A.O.). Puteaux produced 19 M.S.406's in 1940 and S.N.C.A.O. 106. On 25th June 1940 when the armistice was signed a total of 1,098 M.S.406's had been accepted by *l'Armée de l'Air*; 90% of the total were produced by S.N.C.A.O.

Despite this impressive total, production had been considerably delayed; under the *Plan Caquot*, 955 should have been produced by September 1939; only 572 had, in fact, been produced. As with many other French aircraft at this time, chief causes of delay were a shortage of engines and accessories. To counteract this, negotiations were completed for the production of 25 engines per month at the Skoda plant in Czechoslovakia, but the incorporation of Czechoslovakia into the German *Reich* prevented this scheme from reaching fruition. At the same time, unsuccessful negotiations were made to buy Swiss Saurer-built H.S. 12Y 51 and Russian-built M-100 engines. The shortage of engines remained a problem until the Armistice terminated production.

Moranes of the 2e Escadre *at Chartres in summer 1939; note* "Cigognes" *emblem on rear fuselage.*



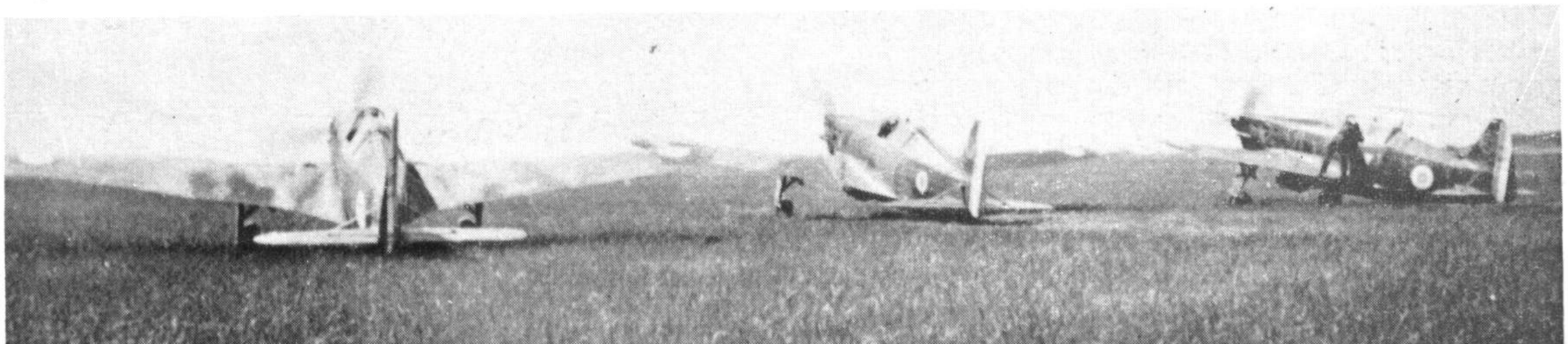
One of the hundreds of combat aircraft which retreated southwards in June 1940; M.S. 406 No. 929 photographed at Montpellier-Frejorgues. By this period many aircraft carried their individual number on the rear fuselage rather than the fin.
(Photo: Archive Dr. Rivière)

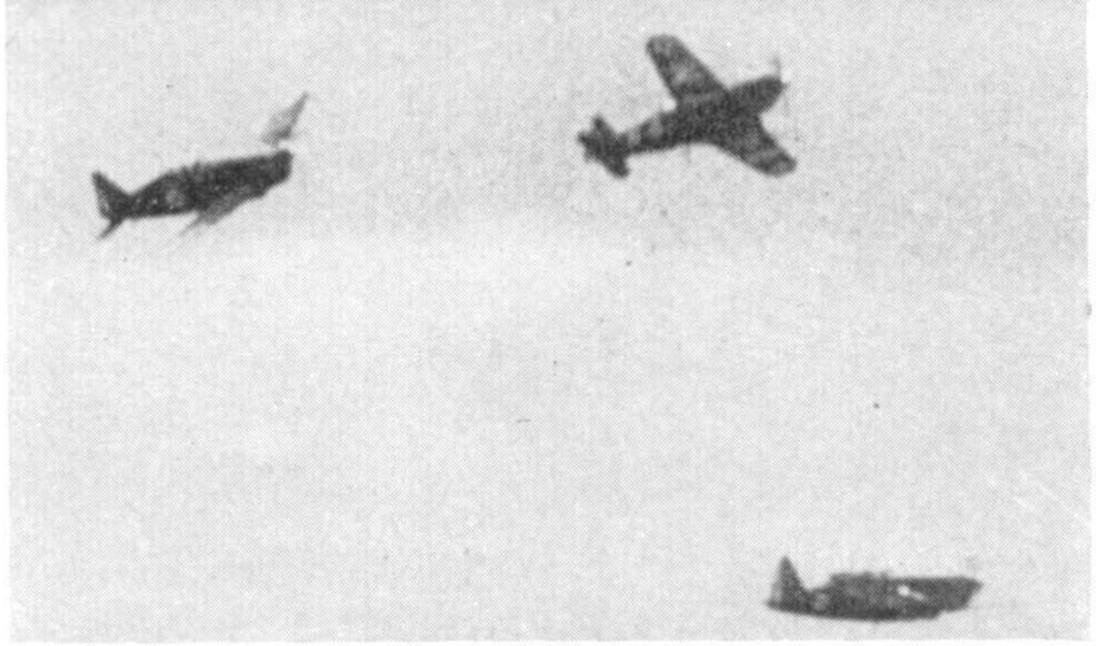
THE M.S.406 IN SERVICE

During May 1938, the 2nd *Escadrille* of the 7th *Escadre de Chasse* at Rheims received some of the pre-production M.S.405's to conduct operational testing. Despite accidents, the pilots were pleased with the new type. After several landing accidents, the undercarriage was strengthened and the weakness of the cabin-hood was rectified by the introduction of a turnover pylon in August 1939. The elevator coverings were re-inforced, but despite complaints about poor fitting attachments of the motor and forward-fuselage covering-panels, no action was taken.

Production M.S.406's followed rapidly following the Service-testing of the M.S.405's. The 6th *Escadre* exchanged its LN 46's for the new fighter during December 1938 and January 1939. The 2nd, 3rd and 7th *Escadres* followed quickly, so that the traditional *Fête Nationale* fly-past over Paris on 14th July 1939 was made with the freshly-converted units taking part. (The Curtiss H.75's ordered from the U.S.A. to make up for the lack of modern fighters in *l'Armée de l'Air* did not arrive as soon as was hoped; the 4th and 5th *Escadres* re-equipped with the type during the period March to May 1939.) On 21st August 1939, just before mobilisation, the Morane equipped twelve groups, of which ten were in Metropolitan France:

A "patrouille simple" *starting up during the Battle of France; note diversity of camouflage patterns.* (Photo: E.C.A.)





A photograph of indifferent quality but unique interest, this view of a "patrouille simple" *returning from a mission in the Battle of France is one of the rare surviving formation photographs of M.S. 406's in this period.* (Photo: E.C.A.)

5 at Chartres:		
G.C.I/2, G.C.II/2, G.C.III/2		a total of 80 M.S.406
G.C.II/6, G.C.III/6		a total of 54 M.S.406
5 at Dijon:		
G.C.I/3, G.C.II/3, G.C.III/3		a total of 78 M.S.406
G.C.II/7, G.C.III/7		a total of 59 M.S.406
2 at Blida: (Algeria)	G.C.I/6	a total of 19 M.S.406
	G.C.I/7	a total of 18 M.S.406

Twenty Moranes were at various training stations in France, 29 in Tunisia and 10 in Indo-China. Out of the 500 accepted at this time, 367 were in operational use.

On 23rd August 1939, as a result of the Polish-German crisis, all *Armée de l'Air* units were moved to their *Terrains de Campagne*. Of the 13 fighter groups (*Groupes de Chasse:* G.C.) ready for combat, and allocated to the three *Groupements de Chasse*, 7 were equipped with the M.S.406. At *Groupement* No. 21, which consisted of 6 G.C.'s and 4 E.R.C.'s (*Escadrille Regionale de Chasse*) the following had the M.S.406:

G.C.I/2 at Beauvais-Tille; G.C.II/2 at Clermont Les Fermes, in support of the Ardennes Army; G.C.III/2 at Cambrai-Niergnies, in support of the 1st Land Army; G.C.III/6 at Villacoublay.

At *Groupement* No. 22, which consisted of 4 G.C.'s, two units employed the M.S.406:

G.C.I/3 at Velaine En Haye, in support of the IVth Land Army; and G.C.II/7 at Luxeuil, in support of the VIIIth Land Army.

From Luxembourg to Switzerland 4 G.C.'s were arrayed in support of the IIIrd, IVth, Vth and VIIIth Land Armies, two flying Moranes and two flying Curtisses.

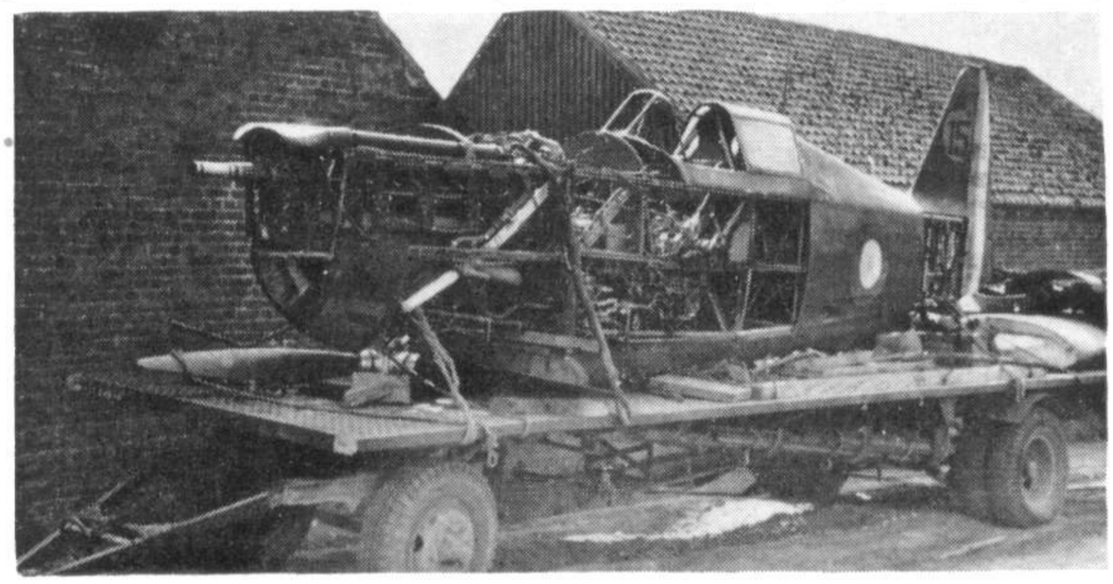
During the Phoney War (*Drole de Guerre*), these units were engaged in *Defense Aérienne du Territoire* (Territory Air Defence) and *Chasse aux Armées* (Army Co-operation). No intensive action occurred during this period, each side testing the others defences with photo-reconnaissance missions and small-scale fighter actions. The French fighters flew a considerable number of missions escorting reconnaissance aircraft (Mureaux 115 and 117 and, Potez 637 and 63-11), during which encounters with aggressive Bf 109's were frequent. They also had to oppose the Hs 126's spotting French lines, but the most harassing work was the interception of Do 17 and He 111 *Fernaufklärer* undertaking photo-reconnaissance flights at altitudes in the region of 25,000 feet. Finally, from March 1940, frequent battles occurred with deep sweeps by single- and twin-engined fighters over Alsace-Lorraine. During the *Drole de Guerre*, a total of 10,119 fighter missions were flown in the Army Zones. September (2,600) and October 1939 (1,400 sorties) were busy months, but the bitter winter of 1939-40 greatly reduced activity, although the following April 1,826 missions were flown. The M.S.406 flew about half of these missions. Among the 81 "kills" and 32 "probables" claimed by all *Groupes de Chasse* during this period 32 "kills" and 16 "probables" were the work of the Moranes (of these, 13 "kills" and 6 "probables" were Bf 109's). Thirteen M.S.406's and 9 pilots were lost in combat, and a further 33 were lost in the *Zone des Armées* due to various causes. Some of these latter were almost certainly due to *Luftwaffe*-inflicted battle damage. German claims for this period (the *Sitzkrieg*) were 159 enemy aircraft, among these 111 French aircraft, of which about 25 were M.S.406's.

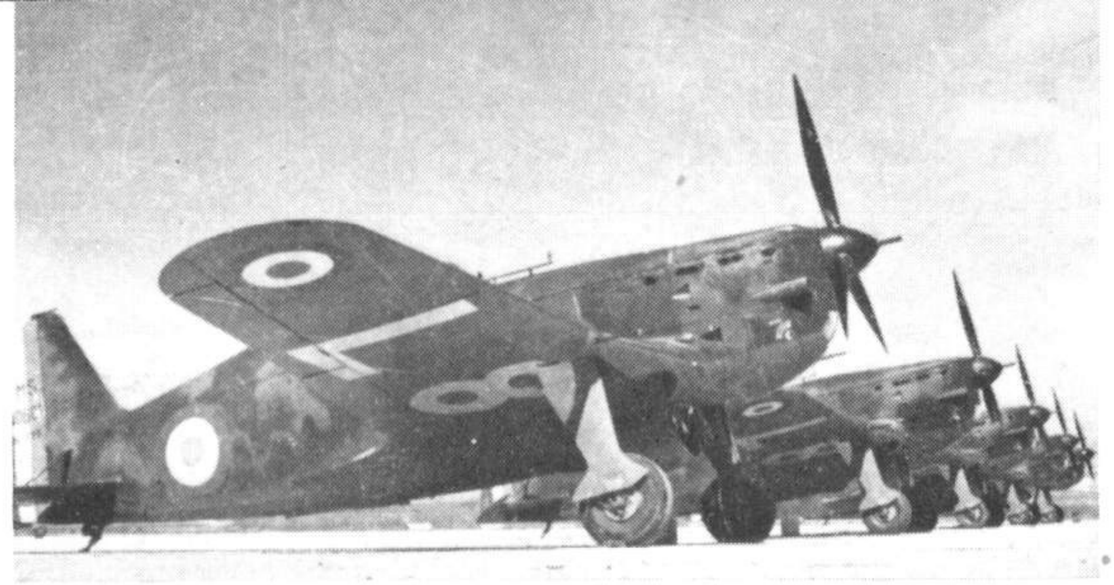
Even though about one-third of the opposing fighters were Bf 109B and D aircraft, and the *Aufklärer* were lone aircraft, the weaknesses of the M.S.406 were apparent:

(1) Lack of armour (partly corrected by the addition of a dorsal shield). (2) Frequent gun-jamming at high-altitude (corrected in some units by using signal-light circuits to feed electric heaters for the gun breeches). (3) Insufficient fire-power, necessitating close approach to "kill"—less than 50 yards on occasion. (4) Pneumatic gun control, giving about 2/10th second "dead time" before firing, making deflection shooting difficult. (5) Malfunctioning of radio sets. (6) Rapid engine-wear, giving even lower speed and climb-rate. (7) Loss of motor and fuselage panels due to deterioration of screws and hinges. (8) Corrosion of rudder parts. (9) Cabin glazing broken by air-pressure in high-speed combat manoeuvres. (10) Lack of rear-view mirror on "factory-fresh" aircraft.

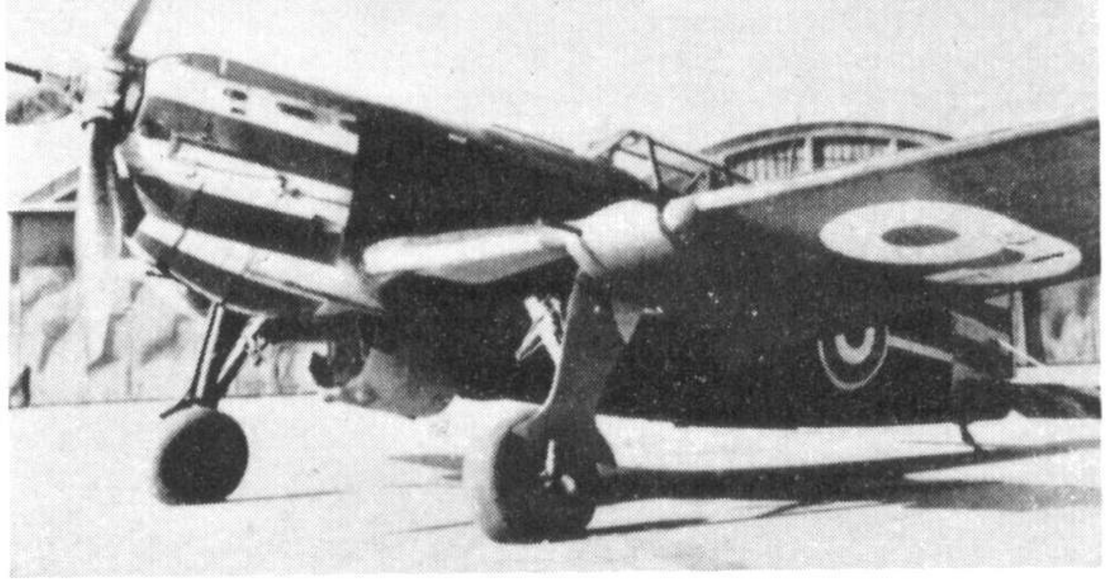
The rapid German advance provided many scenes like this; a Wehrmacht *soldier examines M.S. 406 No. 192, abandoned as unserviceable.* (Photo: Musée de l'Air)

M.S. 406 No. 103 on its journey to a Luftwaffe *establishment for inspection and evaluation. The missing panels show the structure clearly, and also the great number of hydraulic and pneumatic lines.* (Photo: Bundesarchiv Nr. 382/206)





G.C. I/7's Moranes lined up at Rayack, Syria in 1940. The nearest aircraft is No. 829. (Photo: E.C.A.)



A Vichy M.S. 405 with spinner removed, and underwing ferry tanks immediately outboard of the undercarriage.
(Photo: Archiv W. Girbig)

On the other hand the excellent manoeuvrability of the M.S.406 gave experienced pilots great advantage, even over the Bf 109.

The "Phoney War" ended without the intended replacement of the M.S.406 by later types, although G.C.I/3 did convert to the D.520 (see *Profile* No. 135) during the early days of May 1940. The morale of the French pilots was high despite their knowledge of the *Luftwaffe's* technical and numerical superiority.

THE PHONEY WAR ENDS

On 10th May 1940, when the Germans unleashed their attack on France and the Low Countries, 10 *Groupes de Chasse* were equipped with the M.S.406, a total of 278 combat-ready aircraft. Since the end of 1939, all *Armée de l'Air* units had been grouped in *Zones d'Operations*. The line-up of units with the M.S.406 was:—

At Z.O.A.N. (*Armées du Nord*) which received the initial blow:

G.C.III/3 at Beauvais-Tille.
G.C.III/2 at Cambrai-Niergnies,
in support of the Ist Land Army.
G.C.II/2 at Laon-Chambry,
in support of the IXth Land Army.
G.C.III/1 at Norrent-Fontes,
in support of the VIIth Land Army.

At Z.O.A.E. (*Armées de l'Est*)

G.C.II/6 at Anglure-Vouarces.
G.C.I/2 at Toul-Ochey,
in support of the IVth Land Army.
G.C.III/7 at Vitry-le-Francois.

At Z.O.A.S. (*Armées du Sud*)

G.C.III/6 at Chissey.
G.C.II/7 at Luxeuil,
in support of the VIIIth Land Army.

At Z.O.A.A. (*Armées des Alpes*)

G.C.I/6 at Marignane.
G.C.II/3 at Le Luc, converting to D.520.
G.C.II/9 at Marignane,
converting to M.B.152 from 10th May.

Outside France were:—

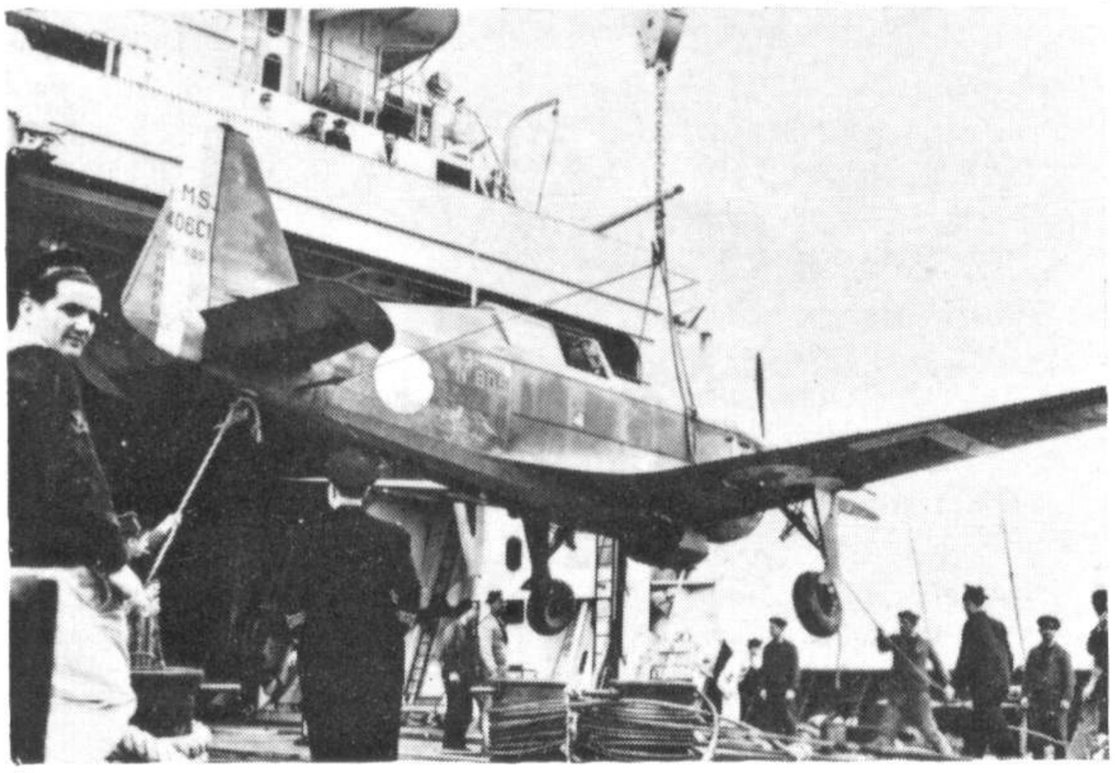
In Corsica: G.A.M. 550 with some M.S.406 and Potez 63-11 aircraft.
In N. Africa: G.C.I/9 and I/10 at full strength and two units, G.C.III/4 and III/5, partially equipped with the M.S.406.
In Syria: G.C.I/7, a well-trained group.

Besides these normal units, a number of *Groupes de Chasse de Defense* (G.C.D.) units were formed for target defence of airfields, plants and depots. Equipped with from 3 to 9 fighters, they were almost exclusively equipped with the M.S.406 and M.B.152. Moranes were used at Bourges (6 aircraft), Montpellier (6), Nantes (4), Romorantin (4) and in many other places. Many Polish and Czech pilots flew these aircraft and a number of "kills" were claimed.

From 10th May, the fighting proved relentless for the Moranes. The *Luftwaffe* supremacy and the rapid advance of the German Army made difficult conditions for the French worse. The repeated abandonment of airfields by the French disorganised repair and maintenance work on aircraft and the groundcrews were unable to maintain a high proportion of serviceable machines. Many aircraft were destroyed or abandoned on their bases. The nature of the air combats was similar to that of the winter, but the methods of intercepting bombers proved costly and utterly inefficient. The use of French fighters in small groups made their task more difficult, and the defensive fire of the German bomber formations, now flying in formations of 9 to 27 aircraft, deterred many pilots from pressing home their attacks. Pilots were emptying their ammunition drums from long range at the bombers and did not achieve very impressive results. For example 6 Moranes of G.C.I/2 pursued a He 111 group for 60 miles on 2nd June 1940 without being able to shoot down a single enemy aircraft. They did succeed in losing one of their own number however. On the other hand, three days later, 9 aircraft of the same group, probably using the experience gained, destroyed 4 Ju 88's without loss.

The Morane was employed against fighters with mixed fortunes, but on occasion, in the hands of an experienced pilot, the Morane achieved impressive results. On 8th June, Capitaine Wuillame of G.C.I/2 destroyed three Bf 109's in 15 seconds—a Battle of France record! The same day 9 M.S.406's of that group, in 16 sorties, shot down 9 confirmed and 2 probable German aircraft, themselves losing one pilot and 2 aircraft. On occasion, the Bf 110 seemed "easy meat" for the Morane. On 13th May, 6 aircraft of G.C.II/2 destroyed 6 Bf 110's in 20 seconds; immedi-

Unloading M.S. 406 No. 805 from the "Commandant Teste" *in Beirut during the transfer of G.C. I/7 in 1940.*
(Photo: E.C.A.)



ately after this they lost 4 aircraft and 3 pilots killed. The Bf 110 pilots frequenty resorted to the *Abwehr Kreis* (defensive circle) technique, often with success, as on 11th June, when 12 Bf 110's "entertained" 5 Moranes over Damblain, damaging a Morane.

Taking the Battle of France as a whole, the M.S.406 was the least effective French fighter, paying a higher price for its victories than the D.520, Curtiss H.75, or Bloch 152. Although all types of French fighters were used in unfavourable conditions against the technically superior Bf 109, and often considerably outnumbered, the M.S. 406 compares badly with other French fighters in similar circumstances, especially the contemporary Curtiss H.75. Out of 144 fighter pilots killed in combat, 75 were flying Moranes. The high ratio of "probables" to "kills" indicates that the weak firepower of the M.S.406 made finishing a "kill" difficult. Also worthy of note is the fact that many Moranes were lost to "flak" while attacking German *Panzer* columns at low-level in the first days of June. Many were destroyed on the ground as shown:—

G.C.III/2 lost 13 M.S.406 on the ground on 10th May at Cambrai.
G.C.III/7 lost 2 M.S.406 on the ground on 10th May at Vitry.
G.C.II/6 lost 14 M.S.406 on the ground on 16th May at Le Quesnoy.
G.C.I/2 lost 8 M.S.406 on the ground on 27th May at Damblain.

During the Battle of France, it seems that about 400 Moranes were lost—about 150 in the air (combat and "flak"), about 100 on the ground and the remainder destroyed by the French themselves before retreating. Total victories claimed by the twelve *Groupes de Chasse* which flew the type during the battle of France were 191 confirmed and 89 "probable". These mediocre results and the complaints of the groups flying the type, resulted in the accelerated conversion to more modern types. At the Armistice, on 25th June 1940, only 4 of the 14 groups stationed in Metropolitan France were equipped with the M.S.406:

G.C.III/1 at Marignane; G.C.I/2 and II/2 at Nimes; G.C.I/6 at Salon en Provence.

Even in North Africa, only 3 out of 14 groups flew the Morane: G.C.III/5 at Bir Guenich; G.C.I/9 at Oudja; G.C.I/10 at Djedeida.

There were 203 M.S.406's in North Africa, including aircraft in reserve depots. In Syria G.C.I/7 still operated the type. The Morane gave the *Armée de l'Air* its last victory (an Hs 126, coded 4E+RN, destroyed by *Sous Lieutenant* Marchelidon of G.C.I/2) and its last victim (*Sous Lieutenant* Raphenne of G.C.I/6 shot down by "flak" during a strafing attack on 24th June).

The redeployment of the *Armée de l'Air* after the Armistice emphasised the obsolesence of the M.S.406: in a note about the dumping of "demobbed" aircraft, the M.S.406 is not placed in the same class as the Le0 451 or Potez 63, but in the same class as such old-stagers as the Potez 58, Caudron Pelican, autogiros and the Le0 H.20. However, the Morane was not yet out of World War Two.

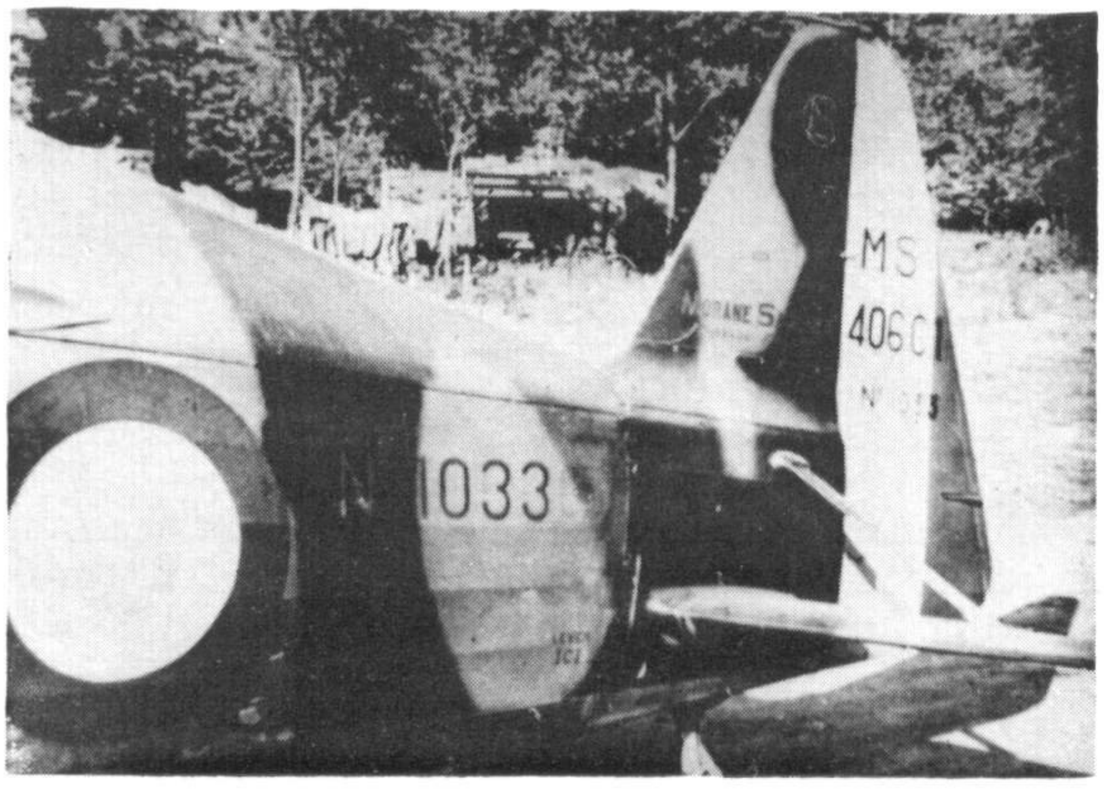
On 20th July 1940, following de Gaulle's speech from England, 7 or 8 fighters escaped from Syria. Assembled in Egypt with No. 274 Sqdn. R.A.F., they fought in the Western Desert until they were no longer airworthy. Some were taken on R.A.F. charge including AX 674 (M.S.406 No. 826), AX 675 (No. 827) and AX 684 (No. 819). With the Vichy Air Force the type was destined to fight against the former British allies. On 8th and 10th June 1941, Moranes of G.C.I/7 were in combat with Fleet Air Arm Fulmars attacking the coast. They suffered heavy losses after 6 were burned on the ground. On 7th May 1942, in Madagascar, 4 Moranes of *Escadrille* 2/565 shot down a Grumman Martlet from the aircraft carrier *H.M.S. Illustrious* before being shot down themselves in Diego Suarez bay. At Vichy-controlled bases, the Morane was relegated to training duties and when the Germans invaded the Unoccupied Zone of France in November 1942, there were less than a hundred in France, of which only 46 were said to be usable by the Germans. In 1940, about 10 M.S.406's were used by the *Aeronavale*, chiefly at Hourtin.

THE M.S.406 IN FOREIGN SERVICE

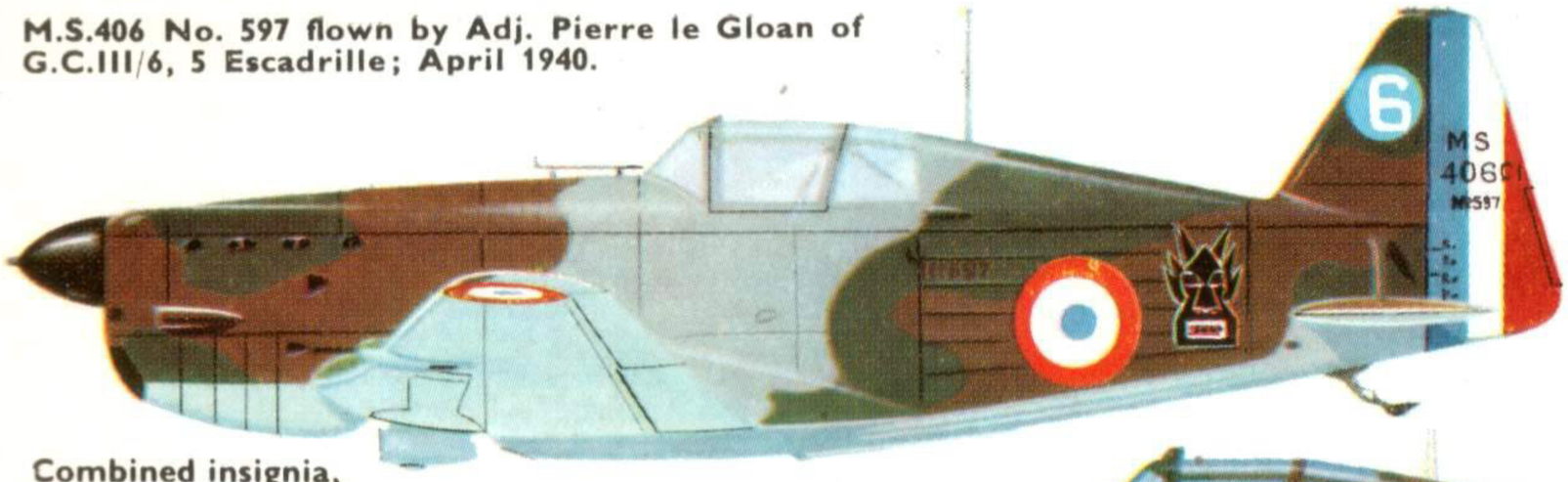
When the M.S.405 was exhibited at the 1936 Paris Salon it provoked considerable interest. Re-armament was just getting under way and the O.F.E.M.A. (export agency of the French aircraft industry) achieved a certain commercial success. In 1937 negotiations took place with members of the Belgian aircraft industry to produce the M.S.406 under licence in Belgium for both the *Armée de l'Air* and the Belgian Air Force, but they came to nothing. Switzerland was to be the first important buyer. After buying two assembled fighters, the first being delivered in September 1938, the *Fabrique Federale des Avions* acquired a manufacturing licence. The D-3800 differed little from the French M.S.406: 82 were built during 1939-40 registered J-3 to J-84. The chief external differences between the Swiss and French machines were as follows: the D-3800 featured an antenna forward of the windshield, lacked an external ring-and-bead sight, did not have machine-gun bulges in the wings and used a tailwheel instead of a tailskid. Later 207 D-3801 aircraft were built, featuring the 1,000 h.p. Saurer-built HS 12Y 51 engine and a non-retractable radiator. An increase of 23 m.p.h. in level speed and 2 minutes reduction in the climb to 5,000 m. (16,400 ft.) was obtained.

The Chinese ordered 12 Moranes (No. 1074–1085) in 1938 and these were produced by S.N.C.A.O. The aircraft reached Haiphong, but there they were seized to form *Escadrille* EC 2, which fought against the Japanese and Thais in December 1940. Despite the death of test-pilot Mikenas, in the M.S. 405-01 on 8th December 1937 at Villacoublay, Lithuania ordered 13 aircraft (Nos. 1074–86). They were never delivered.

Tail details of one of the last Puteaux-built machines, captured in May 1940. (Photo: Archiv Karl Ries)



M.S.406 No. 597 flown by Adj. Pierre le Gloan of G.C.III/6, 5 Escadrille; April 1940.



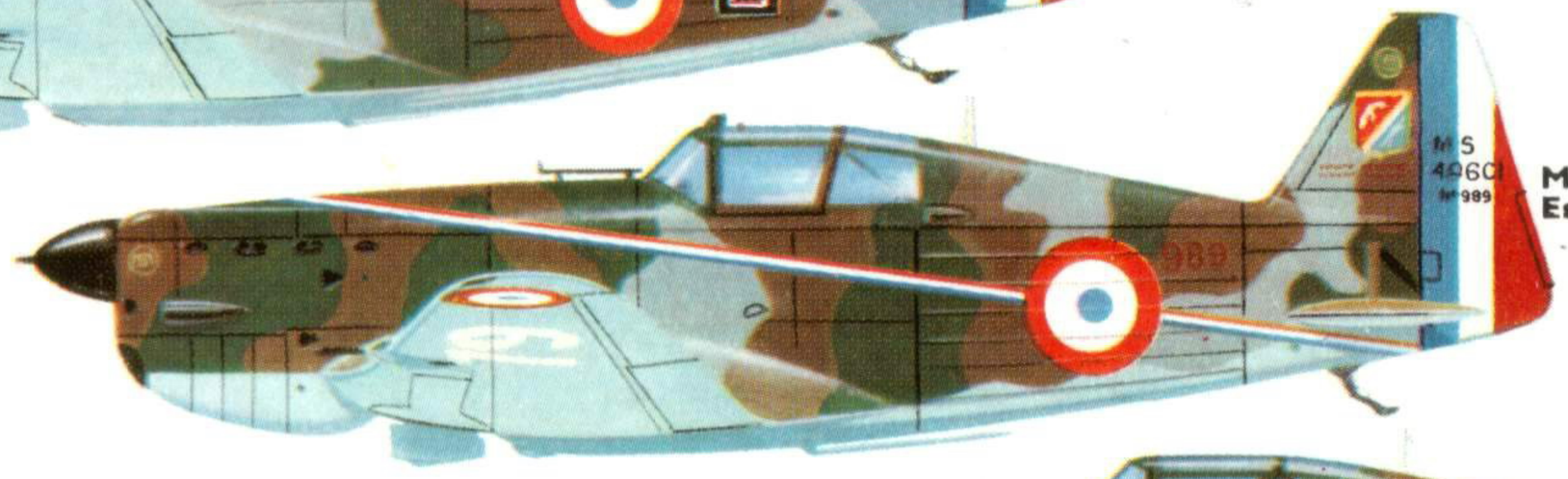
G.C.III/6, 5 Esc.

Combined insignia,

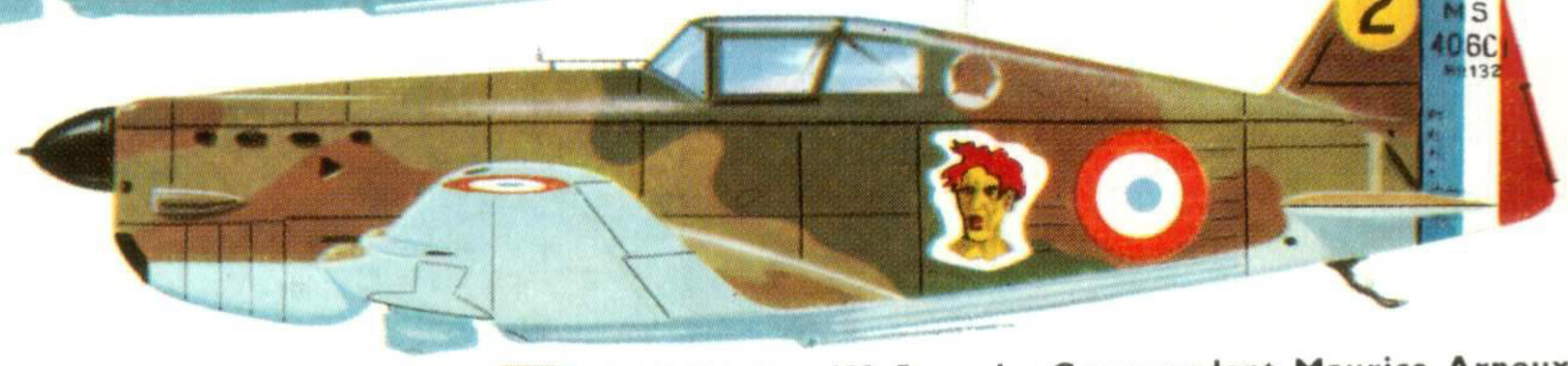
3 and 4 Esc., G.C.II/3.

Arnoux's personal insignia.

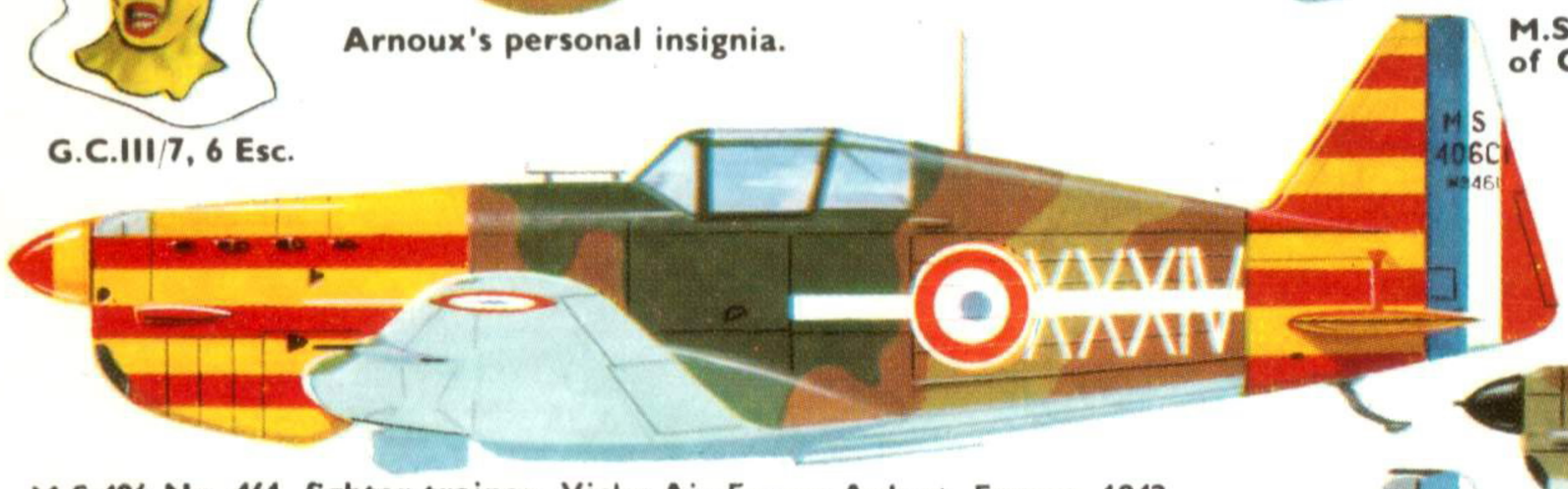
G.C.III/7, 6 Esc.



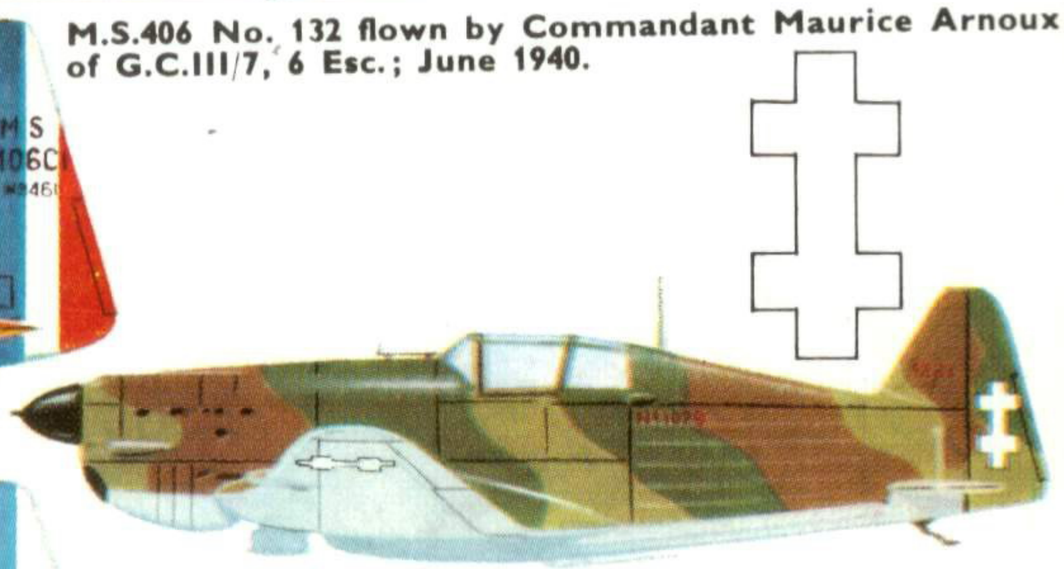
M.S.406 No. 989, G.C.II/3, 3/4 Escadrille; April 1940.



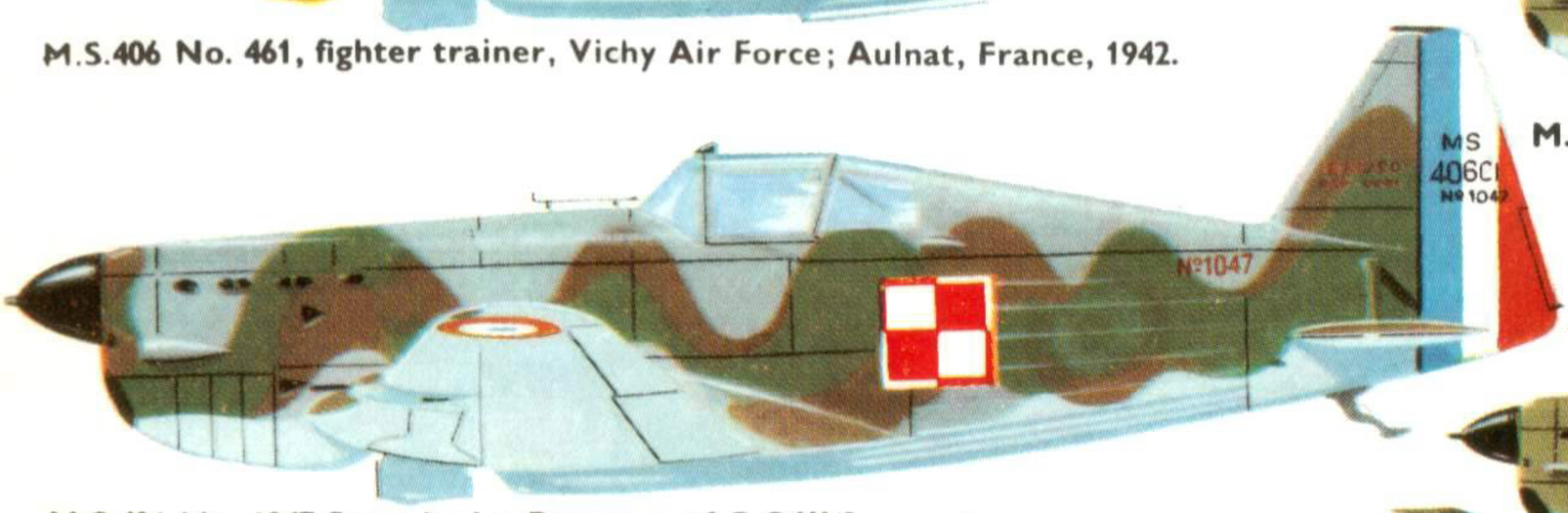
M.S.406 No. 132 flown by Commandant Maurice Arnoux of G.C.III/7, 6 Esc.; June 1940.



M.S.406 No. 461, fighter trainer, Vichy Air Force; Aulnat, France, 1942.



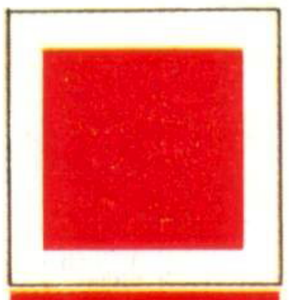
M.S.406, Lithuanian delivery scheme 1939; never delivered.



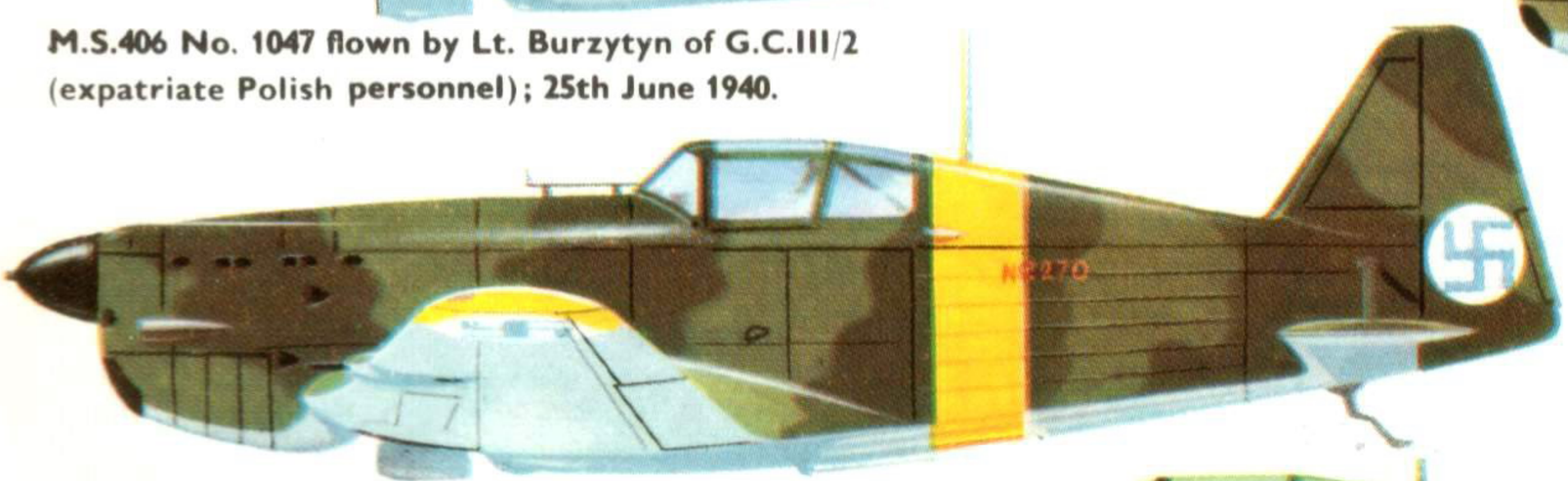
M.S.406 No. 1047 flown by Lt. Burzytyn of G.C.III/2 (expatriate Polish personnel); 25th June 1940.

M.S.406, Turkish Air Force.

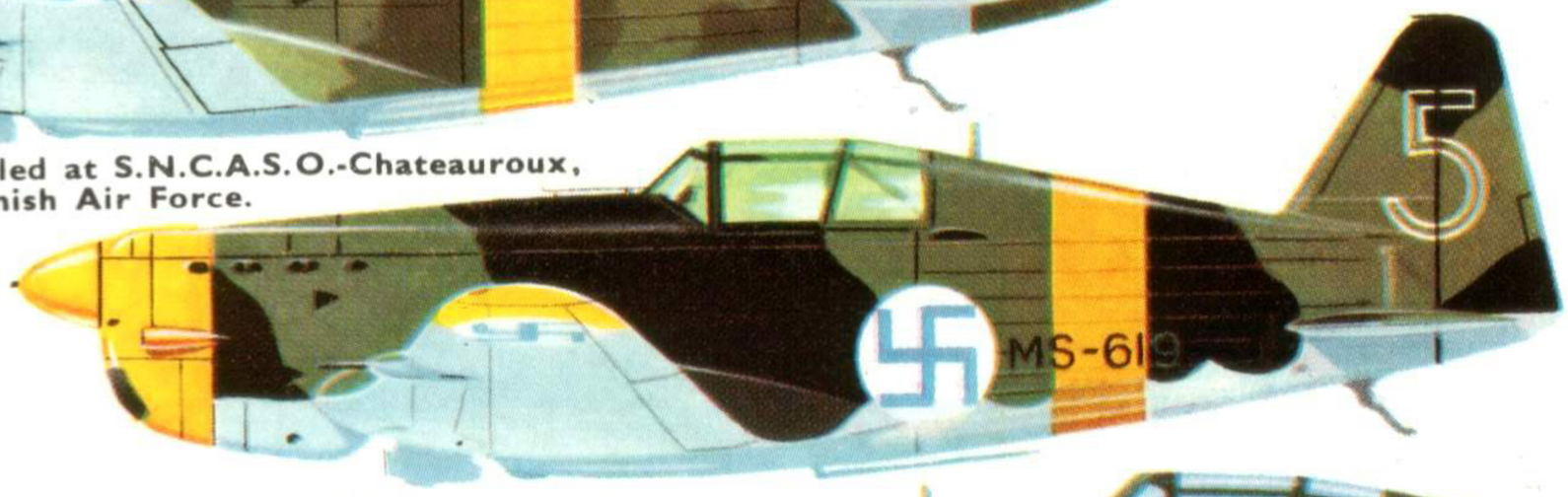
Turkey; Wings



Rudder.

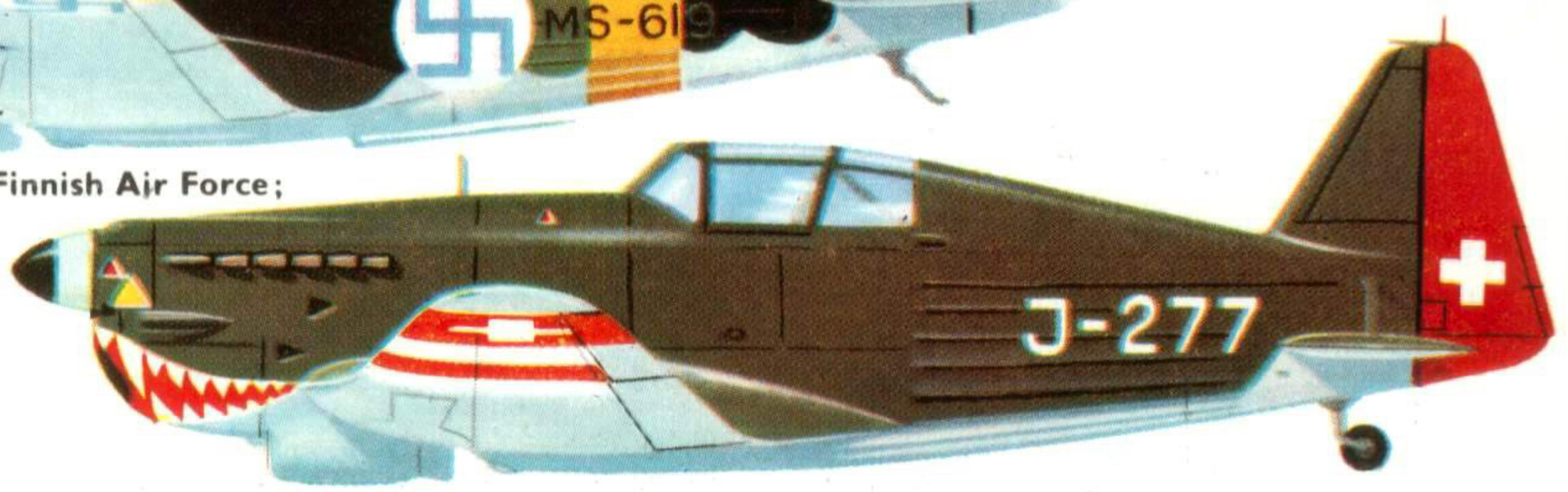


M.S.406 No. 270 overhauled at S.N.C.A.S.O.-Chateauroux, 1941, for delivery to Finnish Air Force.



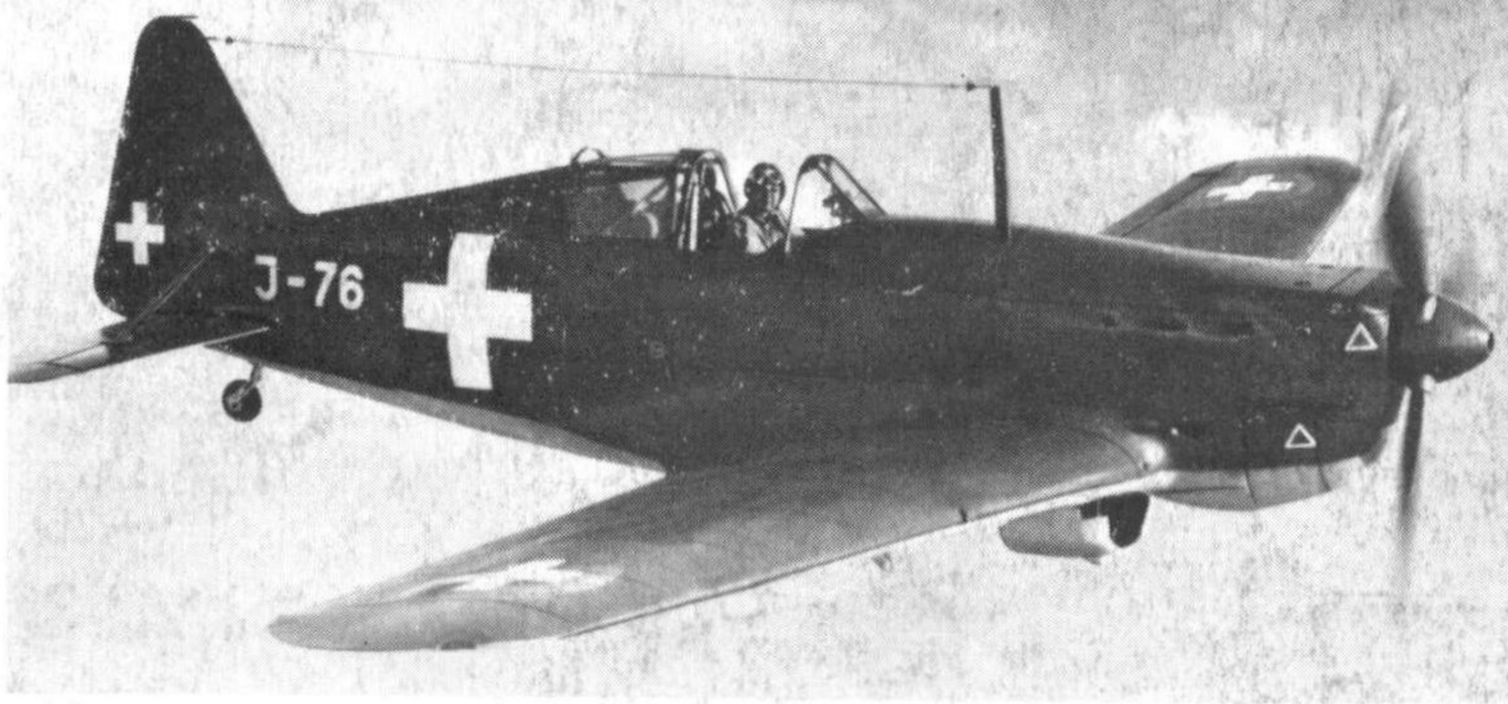
M.S.406, HLeLV 28, Finnish Air Force; Continuation War.

Front view of No. 461.



Pilatus-built D.3801 of Swiss Air Force, May 1945.

© WARD



Fine study of a production D-3800 of the Swiss Air Force.

Following an order for 200 D.520's in June 1939, the General Headquarters of the Air agreed that, in addition to already existing orders, export of 10 Moranes per month, up to a total of 200 machines, could be permitted. The Polish War Minister Kasprzycky ordered 160 M.S.406's, 50 to be delivered before the end of September 1939, the rest at a rate of 20 per month. None reached Poland before the collapse. In November 1939 following Anglo-French-Turkish agreement, Turkey ordered 30 Moranes, followed by an order for a further 15 machines. All were delivered before the Armistice. The country to use the Moranes for the longest period in combat was Finland. During the "Winter-War" 30 were sent with ground personnel. They arrived in January 1940, but only saw three weeks combat before the Armistice. They are said to have scored 15–20 victories during that short period. The "Continuation War" from June 1941 provided the M.S.406 with further action; in fact, further Moranes had arrived in Finland (30 in August 1942), but the LaGG and Yak fighters introduced in 1942-3 proved much superior to the old warrior. The Moranes received an astonishing new lease of life when their Hispano-Suiza engines were replaced with Russian M-105 engines of 1,100 h.p. These had been captured by the Germans during their advance. All existing Moranes were converted and were back in action in 1944. The conversion was 28 m.p.h. faster than the standard type and were designated the M.S.V. or "Mörkö Morane." Yugoslavia was intending to buy 25 Moranes at the time of France's defeat, but no order was then placed.

CAMOUFLAGE AND MARKINGS

Due to the apparent risk of war in 1938-9 the Moranes were camouflaged from the outset, unlike their predecessors the D.500, D.510, LN 46 and SPAD 510. It was possible to distinguish between S.N.C.A.O.- and Morane-Saulnier-built machines by their serial numbers and the inscriptions on the fin. Morane-built machines sported the firm's insignia in copper on the nose and fin.

At first (serials under 100) the type was camouflaged with large irregular areas of green and brown on a khaki base. Later the official paints of dark blue-grey, green and brown were used in smaller areas. All undersurfaces were light blue-grey with white *matricule militaire* markings under the wings (these were letter and number markings for easy long-distance identification). The underwing roundels were large, 1·2 m. (46·24 in.) in diameter, but the roundels on the upper wing surfaces were only 0·30 m. (10 in.) in diameter. There were no roundels on the fuselage sides; usually the *Escadrille* marking was carried there. The aircraft number in the *Escadrille* was painted on the fin. In January 1940, following identification errors, the fuselage roundel was introduced and the upper wing roundels were enlarged. Immediately after the Armistice, the fuselage roundel was outlined in white and a transverse white band was painted along the fuselage. Later the nose and tail of Vichy aircraft were painted with yellow and red stripes; an oblique tricolour with 24 cm. (9·45 in.) bands was painted on the wings.

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SPECIFICATION
Morane-Saulnier M.S.406

Dimensions: Span 34 ft. 10 in. (10·61 m.). Length 26 ft. 10 in. (8·17 m.). Height 10 ft. 8½ in. (3·25 m.). Total Wing Area 172·2 sq. ft. (16 sq. m.). Undercarriage Track 11 ft. 6 in. (3·50 m.).
Weights: Empty 4,177 lb. (1,895 kg.). Normal loaded 5,610 lb. (2,540 kg.). Wing loading 32·6 lb./sq. ft. (154 kg./sq. m.). Power loading 6·52 lb./h.p. (2·95 kg./h.p.).
Performance: Maximum speed 281 m.p.h. (452 km./h.) at 6,560 ft. (2,000 m.). 304 m.p.h. (490 km./h.) at 14,700 ft. (4,500 m.). 273 m.p.h. (440 km./h.) at 26,200 ft. (8,000 m.).
Climb to 6,560 ft. (2,000 m.) 2 min. 32 sec.; to 19,700 ft. (6,000 m.) 9 min. 3 sec.; to 29,500 ft. (9,000 m.) 21 min. 37 sec.
Range at maximum speed at 13,100 ft. (4,000 m.) 447 ml. (720 km.); at 33% power (200 m.p.h.—321 km./h.) 683 ml. (1,100 km.).
Service Ceiling 32,800 ft. (10,000 m.). Normal duration 105 min.
Fuel Tankage: Total internal petrol 89·3 gall. (406 l.). Oil tankage 10·8 gall. (49 l.).
Engine: One Hispano-Suiza HS 12Y 31 12-cylinder 60° Vee Liquid-cooled engine rated at 860 h.p. at 13,100 ft. (6,000 m.); 760 h.p. at sea-level and 860 h.p. for take-off. The engine drove a 9·82 ft. diameter Chauvière *Série 351* two-position airscrew.
Armament: One 20 mm. Hispano-Suiza type HS 59 or HS 404 cannon with 60 rounds of ammunition firing through the airscrew hub and two MAC 7·5 mm. machine-guns with 300 rounds each in the wings.

COMBAT

The table shown here gives some impression of the ferocity of combat during the Battle of France. It records the activity of G.C.II/6 reinforced by the 6th *Escadrille* of G.C.III/3, between 10th May and 17th May 1940.

	Total	G.C. II/6	6th Esc. of G.C. III/3
Victories	22 (13 confirmed)	15	7
Pilots missing	6	5	1
Pilots shot-down	15	10	5
Pilots wounded	7	4	3
Aircraft lost in combat	14	9	5
Aircraft destroyed on ground	19	19+?	?
Missions flown	260	198	62
Missions during which combat occurred	108	77	31

More than 33 aircraft were lost in a week out of a nominal strength of about 45.

FRENCH PILOTS' VICTORIES

Outstanding among the *Armée de l'Air* pilots were *Capitaine* Wuillame of G.C.I/2 with 8 confirmed victories and 1 "probable", *Sergent* Le Nigen of G.C.III/3, 8 confirmed victories (killed on 25th July 1940), and *Adjutant* Gagnaire of G.C.III/1 with 7 confirmed victories and 2 probables (killed on 10th June 1940). A total of 8 other pilots had 5 or more confirmed victories.

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